OCTOBER, 1916 15 CENTS

The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED

THE WIRELESS GIRL

SEE PAGE 396

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Receive Wireless "Whispers"

just as readily as distinct nearby signals. You can easily do so, if you use a Brandes Wireless Head Set. The two receivers are perfectly matched in tone. The result is greatly increased sensitiveness, enabling you to pick up weak long distance signals and read them clearly. At the same time nearby-signals are not over-emphasized.

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Brandes Wireless Receivers

C. BRANDES, Inc., Wireless Receiver Specialists
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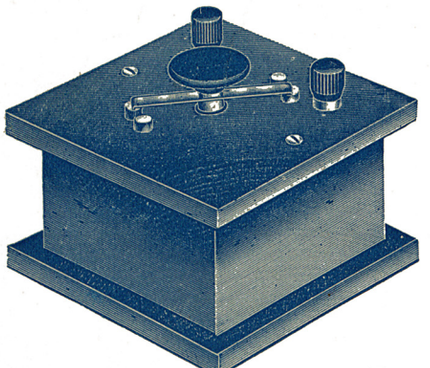
PERMANENT

TEL-RADION Co.

WIRELESS DETECTOR



Send for Bulletin E

Describing improved types of loose couplers and time signal stations.

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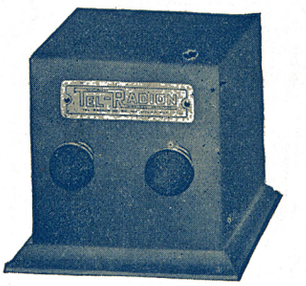
RADIO STATIONS OF THE WORLD—This little vest pocketbook formerly sold for 50c a copy. We have only a few left which we will sell at 25c each. Contains the call letters of all commercial wireless stations of the world; alphabetically arranged.



DUPLEX TEL-RADION

EXPERIMENTING and EXPERIENCE have developed some great improvements in our TEL-RADION PERMANENT WIRELESS DETECTOR.

We have produced two new types of detectors which meet all requirements and conquer all the difficulties experienced with other detectors.

Our new DUPLEX TEL-RADION is a wonder. It enables the operator to attune separately to local or long distance stations by merely turning the rotary switch. Close tuning is instantly accomplished without disturbing the connections or changing the adjustment. It is like having two detectors, one sensitive, the other super-sensitive, but combined in one.

WITH THIS IMPROVED INSTRUMENT WE RIVAL THE HIGHEST PRICED AND MOST COMPLICATED DETECTOR ON THE MARKET.

The DUPLEX TEL-RADION is enclosed in a highly polished solid mahogany cabinet, size 4½ by 4½ by 3 inches and equipped with a duplex rotary switch, with all metal parts heavily silver-plated.

Though we have increased its sensitiveness and efficiency by several hundred percent, we have not increased the price which remains as before.

BY PARCEL POST PREPAID **$5.00**

FOR PERMANENCE, RELIABILITY AND ULTRA-AUDIBILITY YOU SHOULD BUY THE DUPLEX TEL-RADION PERMANENT DETECTOR.

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The TEL-RADION JUNIOR is also a new and improved instrument involving the same invention and construction as the DUPLEX TEL-RADION except that the duplex feature is not included.

Our object in producing the Junior type is to enable you to secure a sensitive and efficient PERMANENT DETECTOR suitable for all ordinary purposes, at as low a price as you must pay for the ordinary detectors that require constant attention, twisting and adjusting and lack the fundamental quality of permanence. Enclosed in a Flemish finished solid oak case, with composition binding-posts.

THE PRICE OF THE TEL-RADION JUNIOR PARCEL POST PREPAID **$2.00**

A VERY EFFICIENT INSTRUMENT IS THE TEL-RADION JUNIOR

REMEMBER WHICHEVER INSTRUMENT YOU SELECT OUR GUARANTEE APPLIES TO EITHER. MONEY BACK IF NOT SATISFIED.

A TEL-RADION PERMANENT WIRELESS DETECTOR (EITHER OF THE ABOVE DESCRIBED TYPES) IS GUARANTEED PERMANENT AND RELIABLE. IT IS A MARVEL AT ELIMINATING STATIC.

NO BATTERIES REQUIRED
NO OPERATING EXPENSE
EASY TO OPERATE
NO LOST MESSAGES

NO DELAYS OR INTERRUPTIONS
ALWAYS RELIABLE AND EFFICIENT
IT NEVER FAILS YOU FOR AN INSTANT
NO SET SCREWS OR FINE ADJUSTMENTS

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WIRELESS INSTRUMENTS

Greatest Sale in the History of Wireless

Send postal today for pamphlet showing prices averaging a discount of 30% on 100 of the most popular wireless instruments in our catalog

Sale originally intended for June only but inability to reach all our patrons caused thousands to whom notice came later to ask for an extension. We have therefore extended the sale during the months of July and August. Sale closes positively on August 31st.

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150 Pages Wireless Instruments **150 Pages Electrical Supplies**

Only 8c. in stamps will bring this unrivalled catalog to your home. The great cost of catalog and the exceptionally low prices (oftentimes fully 25% below usual retail price) prohibits its distribution otherwise. You may deduct the 8c. on first $1.00 purchase.

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150 pp. Wireless Instruments, magnet wire of all kinds, raw material, storage batteries, telegraph instruments, battery motors, commercial motors and generators, sewing machine motors, telephones, step-down transformers, massage vibrators, bells, push buttons, auto accessories, flash lights, hand lanterns, auto and miniature lamps, Xmas tree outfits, voltmeters, ammeters, lighting plants, Victrolas, air rifles, electric aeroplanes, model builders, electric railways, electrical and mechanical books and general electrical supplies.

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WEIGHT ONLY 10½ OUNCES—This means comfort to the wearer, even when worn for hours at a time.

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PERMANENCE OF ADJUSTMENT—Spools and magnets are mounted in an aluminum cup—diaphragms are permanently fastened to the earpieces; cores are ground to a proper height=so that **the adjustment is permanent.**

Holtzer-Cabot Receiving Telephones Increase Efficiency

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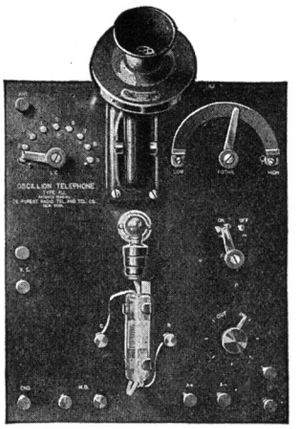
Do you realize that a thoroughly practical **Wireless Telephone** simple enough to be used by anyone has been produced?

A GREATER INVENTION THAN WIRELESS TELEGRAPHY

You don't have to be an operator to use the new **De Forest Radio Telephone Transmitter.** Anyone can talk over it the same as over the wire telephone, and the speech is *clear and distinct* and free from all metallic noises.

APPLICATIONS

For yachts, house boats, barges, commercial ships, tugs, lighters, power transmission companies, railroads, mining camps, logging operations, lumber camps, insular communication, farm service and a thousand other uses, where a practical, dependable telephone is a necessity.



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For one complete station comprising transmitter, receiving outfit, Motor Generator and all accessories,

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We offer radio telephone sets to cover from 1 to 150 miles, either transmitting sets alone or complete stations

ADVANTAGES { LOW INITIAL COST, LOW OPERATING COST, THOROUGH RELIABILITY
CLEAR DISTINCT SPEECH, NO SPECIAL OPERATOR REQUIRED.

Enclose stamp for new bulletin F.16 on oscillion type Radio Telephones

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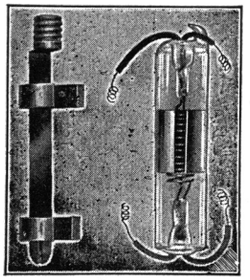
"There is only *one* Audion—the De Forest"



THE GENUINE DE FOREST TUBULAR AUDION

Is sold separately to any amateur who prefers to build his own Audion Detector **Price $5.50**

Adapter 40 cents extra.

Get the Bulletin (X16)

MOST SENSITIVE

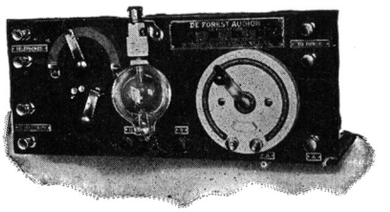
The Bulletin of the U. S. Bureau of Standards states that the De Forest Audion is fully 50 per cent. more sensitive than any other known form of detector (Vol. 6, No. 4, page 540).

MOST RELIABLE

It is not affected by mechanical vibration nor burned out by static or the transmitting spark. It never fails at the critical moment.

The detector is the heart of the receiving set. Why waste valuable time on an insensitive, unreliable detector?

The genuine De Forest Audion is now within the means of every operator.



THE TYPE RJ9 DE FOREST AUDION DETECTOR

Incorporates the Audion Bulb and the genuine De Forest patented circuits with the most approved accessories needed to form a complete detector.

The most popular Audion Detector ever offered. **Price $14.00**

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WARNING—You are entitled to the genuine Audion, guaranteed by the owners of the Audion patents, when making an investment of this kind. Any evacuated detector having a filament, a grid and a plate, as well as other types, are covered by our patents, and several irresponsible infringers are being prosecuted. To be safe and get full value for your money, insist on the genuine De Forest Audion.

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Gravitation

WHEN we pick up a stone and release it, it immediately drops down to earth. So commonplace is this experiment that no one ever seemed to question it for thousands of years. The few philosophers who perhaps did question it, never came anywhere near answering this riddle to their satisfaction.

It continued to be one of the greatest puzzles of all times till the brilliant Sir Isaac Newton in 1687 published his "Principia," giving his explanation of the universal rule of the law of gravitation.

Though the immortal Newton has given us more accurate insight into the mechanics of gravitation than any one man, he died, never knowing *what* gravitation was. In this respect he was much like the equally brilliant Faraday, thanks to whom we have learned more about our most important electrical laws than of any other scientist. He, too, died not knowing *what* electricity was.

It is safe to say that, had Newton lived to-day, he would no doubt have greatly enriched our present knowledge of gravitational phenomena. Unhappily he was born before the days of electro-magnetism, a fact which is to be forever deplored.

Any school-boy can tell the cause of an apple falling from a tree. His answer will be: Because the earth *attracts* the apple.

But *why* the earth should attract the apple, not even Newton could guess; nor could our most able scientists up to a comparatively short time ago.

While Newton's law of Universal Gravitation has stood the test of time, and while it has been accepted by every modern thinker, he thought that gravitation was instantaneous. To elucidate:

Newton imagined that if the earth, for example, due to some titanic cataclysm, should be thrown from her path, the effect would be felt *instantaneously* throughout the entire planetarian system and beyond. We know to-day that this is not the case. Indeed, we know that gravitation requires time to act through space, and the most surprising fact is that gravitation takes as long to travel as light or electro-magnetic (wireless) waves; to be exact, it travels at the rate of 186,000 miles per second, which is the speed of light rays and electro-magnetic waves. Thus, coming back to our imaginary case, if the earth was suddenly thrown from her present path, the effect would be felt on the sun *in eight minutes* after the cataclysm took place, not instantly. In other words, it takes gravitation, traveling at the rate of 186,000 miles a second, eight minutes to bridge the gulf of 92,894,000 miles separating the earth from the sun. A rather startling fact, but true nevertheless.

We know to-day that light is of electro-magnetic origin; as a matter of fact, light rays themselves are electro-magnetic rays. Both are of the same family, the only difference between the two being that light waves are appreciably shorter than electro-magnetic waves.

Because gravitational "waves"—for waves they probably are—travel at the same rate of speed as the other two, the thought lies near that gravitation must of necessity be an electro-magnetic phenomenon. This is but a theory to-day, but it has been generally accepted as correct.

No one has as yet measured gravitational waves, but the day seems not distant when some modern Hertz will open the way for the gravitational Marconi of the future. For it was Hertz who discovered the electro-magnetic (Radio) waves, and Marconi who showed us how to use them outside of the laboratory.

If an indirect proof were wanting that gravitation is really an electro-magnetic phenomenon, we have but to reflect that gravitation acts upon everything imaginable, except on light, heat or electro-magnetic waves.

It has been shown experimentally that gravitation has no effect on light or electricity; in other words, a ray of light or an electric current meets with no more resistance when traveling away from the surface of the earth than when traveling towards it. Thus, the gravitational effect of the moon on the earth is so enormous that it lifts up millions of tons of water, thereby creating our tides. But this immense force has absolutely no effect upon the weakest light ray shot down to earth—and right past the moon—from the most distant star.

To say that light or electro-magnetic waves have no mass, consequently no weight, is begging the question. Newton himself proved that if a body were to be removed out in space so far away that no celestial body would have any influence upon it, that body, though obviously having mass, would be *weightless;* it also would remain freely suspended in space. This fact of course is very obvious.

Man will begin to really live on that day when gravitation shall have been mastered. The day will come when he will make his body weightless, when he can release a stone without it falling down to earth. That day will find him ready to leave the earth in a *real* flying machine, not dependent upon the atmosphere. On that day he will venture forth towards the moon and towards our nearest planets.

Then, and only then, can man call himself emancipated.

H. GERNSBACK.

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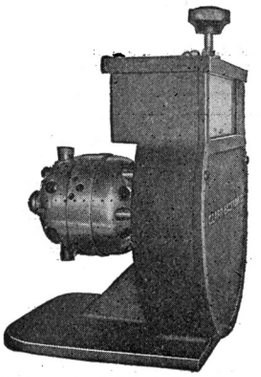
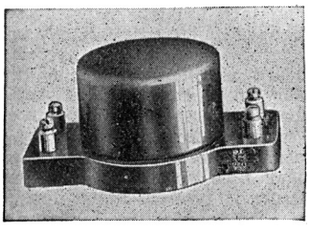


Semi-Quenched Cambridge Rotating Discharger

The Cambridge Semi-Quenched rotating spark discharger is completely enclosed, has glass-covered inspection opening, variable speed motor of the highest quality and operates on any wireless transformer. **Price $32.50**



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We build high grade apparatus and avoid making things so cheap they can't be good

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your small orders aren't welcome. Your order for a binding post or nut will receive the same attention as a larger one, the best service we can give.

Our two catalogs, aggregating 160 pages, contain not only a complete list of Radio and Electrical apparatus but also many small parts and raw materials often difficult to obtain.

Both books sent for 6c postage

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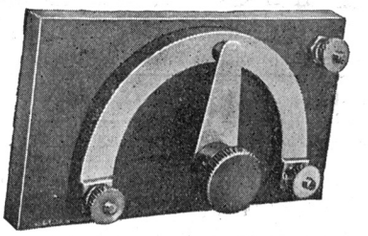

Graphite Potentiometer

Graphite Potentiometer resistance 4000 ohms carbon contact point.

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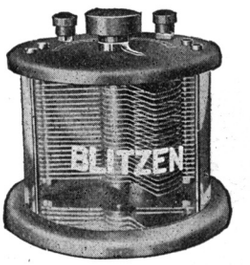

The Blitzen Rotary

variable condenser has a glass case because we're proud to show its high grade material and workmanship. You'll only need one glance to see its aluminum plates, accurately machined brass separators and substantial bearings.

43 Plate condenser, **Price $4.50**
17 Plate condenser, **Price 3.50**

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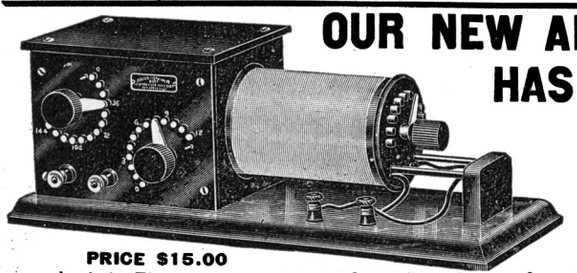
OUR NEW AMCO NAVY TYPE LOOSE COUPLER HAS MADE A TREMENDOUS HIT



PRICE $15.00

THE NEW AMCO NAVY TYPE LOOSE COUPLER embodies the most recent advances in the design of receiving transformers. High frequency resistance loss, capacity loss and leakage have been cut down by the use of special materials and methods. The primary winding is enclosed in a cabinet, the sides and top of which are polished black FORMICA, giving a finish and having insulating qualities far superior to hard rubber. FORMICA is also unbreakable.

Two 13 point switches on the front, control the primary by groups of several turns and by single turns respectively, thus giving a variation of from *1 to 156 turns in steps of one turn at a time*. The secondary is wound with a special silk covered wire. The ends are polished FORMICA. A very fine adjustment of the secondary is secured by a 12 point switch. This coupler is adapted to both short and long wave reception, and we guarantee it to be superior in every respect to any other coupler on the market or your money back.

Order one of these instruments today, keep it 10 days, and then if you don't like it send it back and we will refund your money by return mail

OUR NEW BIG 232 PP. UNRIVALLED ELECTRICAL AND WIRELESS CATALOG IS THE EXPERIMENTER'S REFERENCE BOOK

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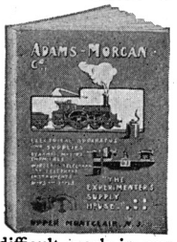

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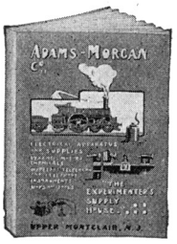
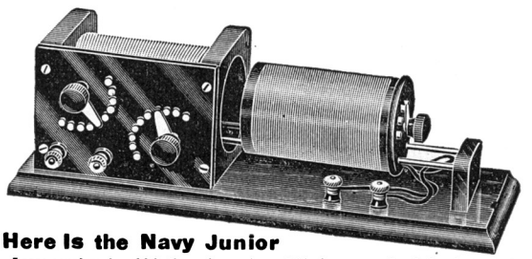


IF YOU ARE BUILDING SOMETHING WE HAVE JUST WHAT YOU HAVE BEEN LOOKING FOR



Here Is the Navy Junior

Loose couplers in which the primary is variable by means of switches instead of a slider have become so popular that we have brought out this wonderful little instrument to meet the demand at a medium price. The primary is fitted with a genuine hard rubber panel across the front. Two ten-point switches are mounted on the panel. One switch controls the primary winding in groups of ten turns at a time while the other switch controls one turn at a time. The primary is therefore easily and quickly adjusted in steps of one turn at a time by the rotary motion of two knobs.

The secondary is variable by means of a multi-pointed switch, controlled by the same handle that varies the coupling. The secondary is carried on two rods and slides with easy movement in and out of the primary. The proportions of this tuner have been worked out by careful experiment and is very efficient. The instrument is beautifully finished in dark mahogany, with gold lacquered brass trimmings.

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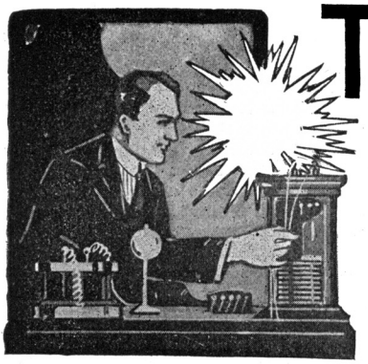


THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 42 OCTOBER, 1916 Number 6

The Electric Villa of a Thousand Wonders

By Jacques Boyer

Paris Correspondent of "The Electrical Experimenter."

HAVING heard of a wonderful electrical mansion in the suburbs of Paris, I straightway decided to visit it and explore its wonders myself.

The name of the owner and builder of this unique and ingeniously constructed mansion is M. Gëorgia Knap. I at once sought his acquaintance and upon expressing my interest in his electrical house, he cordially invited me to visit him upon a fixed date. Accordingly I proceeded to the *Villa Féria Electra.*

Upon my arrival at the outer gate I pushed a button located conveniently near the owner's name. Upon my doing so, a loud though pleasant voice emanating from one of the stone pillars interrogated me as to my name and business. Having tendered this information and having been bid "welcome," the massive iron gate before me opened silently and as I passed through the archway to the magnificent gardens surrounding the house, the voice bade me to refrain from closing the gate, as it would do so of itself—and it did, much to my amusement.

I reached the porch of the mansion directly, and as I stepped upon the floor the front door opened automatically. And still no human being appeared to welcome me. It truly was a most remarkable experience—though by this time somewhat disconcerting.

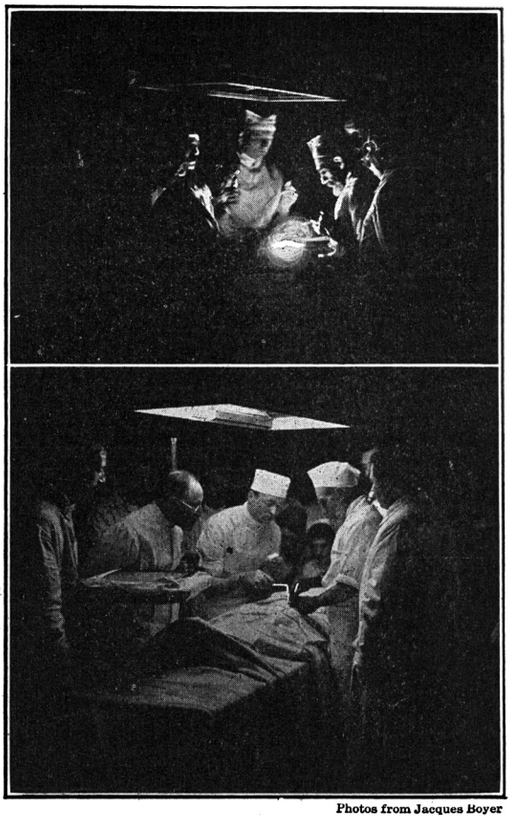
A Wonderful French Electrical Mansion. 1. The Dining Table Served Entirely by Electricity from Kitchen Below. 2. This Dish Has Just Arrived from Below and Travels from Guest to Guest. 3. The Electrified Bed Chamber, Provided with Self-Closing Windows and Curtains. 4. The Chef's Domain, Where Electricity Boils the Eggs and Broils the Chicken Automatically.

X-RAYS AND RED LIGHT AID MODERN SURGEON.

TO Professor J. Bergonié of Bordeaux, France, the medical world owes in a large measure many of its latest improvements in electrical and allied devices. One of his remarkable discoveries is the fact that if the operating room, or rather the patient to be operated upon by the surgeon, is first illuminated with a pure red light as in the illustration herewith shown, with intermittent inspections by the usual X-Ray, that practically no eye fatigue became noticeable in the transition from the red illumination to the greenish X-Ray fluorescence.

The surgeon working under ordinary lighting conditions with the X-Ray, especially where it is to be used in conjunction with an operation, experiences difficulty in quickly perceiving the fluoroscope screen image. The new method of Bergonié is based on the law of simultaneous contrasts of colors or on the simple phenomenon known to most school boys and girls that, if the eyes are allowed to rest upon a certain color or shade for a few moments, then the eyes will retain this impression for several seconds when they are turned away from the color. This effect is termed the *persistence of vision* and owing to this phenomenon it is possible for us to have the modern motion picture. Each picture in the modern movie lasts for about one-sixteenth of a second, and if the retina of the eye could change faster than this with respect to the luminous impression made upon it by each successive picture, then we would not be able to enjoy the present motion picture at all, as we would see each *individual scene* as it is rapidly projected on the screen.

Several odd phenomena of this nature occur, as for instance when you gaze at a red disc and then turn to a similar disc of pure white the latter will appear to have a greenish tint. Again it will be found that if the second disc, instead of being white, happens to be of a greenish shade, it will be noticed that the green is intensified by the green impression made by the red vision. In a like manner if the eyes are fixed on the red disc its color will be intensified with the red impression transmitted to the retina of the eye by the green disc; the two colors thus reciprocally improve each other. These facts have been utilized in working out the new system of surgical illumination by Professor Bergonié and satisfactory results are claimed for it.



Photos from Jacques Boyer

Using the Red Light in Conjunction with X-Rays for Surgical Operations so Enable the Surgeon's Eyes Becoming Accustomed to the Change in Light More Readily. Top View—Using X-Ray on Patient; Below—Using the Red Light.

The surgeon in using this system of illumination stands in a darkened chamber and only the pure red illumination above the operating table is used. Thus the sensibility of the surgeon's eyes is well conserved and may even be increased in the course of the operating period. Now, when the X-Rays are thrown on from beneath the operating table to aid the surgeon and his assistants in exploring the portion of the body being operated on, they are able to perceive very quickly and without any loss of time, the fluoroscopic images of the bones, which appear in a greenish tint. In other words, the retina of the eye accommodates itself not only quickly but efficiently, to the change in color of the illumination. Usually there are but a small number of X-Ray inspections necessary during the progress of the surgical operation. In one case where a piece of shrapnel had to be extracted from a man's heel, two radiographic examinations were necessary. The time period of fluoroscopic inspections required hardly ever cover a period longer than thirty seconds and seldom this length.

In another case where a shrapnel splinter was dislodged from the region of the thigh bone and four inches below the surface of the flesh, necessitated six radioscopic inspections. This always depends of course upon the build of the patient, a thin person naturally requiring a less number of such examinations than one of extreme muscular development.

The dome over the operating table as shown in the accompanying illustration is about the same size as the table itself, to avoid casting shadows on the patient, and is lighted by about twenty twenty-five candlepower lamps placed behind a sheet of pure red glass.

An electric apparatus for washing smoke has been perfected to relieve cities of the smoke nuisance. The smoke is driven by fans through a column of water which washes out the soot and cinders. Pittsburgh papers please copy!

Instead of the human welcome, which I still looked forward to, a peculiar scraping motion at my feet arrested my attention and I found that my boots were being cleaned by a set of electrically operated rotary brushes.

And at this juncture, Monsieur Knap himself appeared to welcome me in the name of the *Villa Féria Electra*. It became evident from my host's manner that he was a thoroughgoing Frenchman, some forty-eight years of age, and, as I presently learned, hailing from the city of Troyes.

We first visited the inventor's marvelous electrical laboratory where there were a hundred and one different apparatus, many of which I had never seen or even heard of before. Surely this man must be an investigator of electrical matters to a very thorough degree. How correct I was in this assumption was to be impressed upon me more than once during my short but profitable stay.

The next point of interest proved to be the dining-room of the Villa, which, although not of large dimensions, was most elegantly furnished. The dining-room table, which resembled a larve oval, was at first glance an ordinary one. But M. Knap demonstrated shortly that it was not that. No *garçon*, no matter how polished or elaborate his poise, ever reaches this apartment. Electricity performs all the multifarious duties of waiter and butler for the serving of the food and wine in a most efficient yet quiet manner.

In the illustration herewith showing the table the tubes just back of the table's edge are miniature *gates*, which serve to prevent the guests at the table from inadvertently pushing any dishes onto the moving belt system by which the dishes progress around the table from one guest to another.

The soup, for instance, is sent up by the Chef from the kitchen in a tureen which appears before the host. He serves himself to a plate of soup and the tureen then moves along to the next guest, who also avails himself of his portion. The napery, cutlery, et cetera, are sent up from the kitchen in a small basket, which travels around the table in the same manner as the soup tureen.

M. Knap then proceeded to show me how orders were given from the dining-room to the kitchen or other servant's quarters, by a portable switchboard in the form of a tabouret, which can be wheeled about the apartment to any desired position. By simply pressing a button on this switchboard the illuminated decorations were brought into play, showing a handsome statue at one end of the room. Also beautiful artificial flowers, as shown by the illustration herewith, were lighted, forming a perfect garland about the table.

After we had been shown how the various courses were sent up to the table, at the conclusion of the meal a turn of a switch demonstrated another novelty in the form of an electric blower, which wafted a current of perfumed air through the room.

Should one of the guests suffer from cold feet while he is at dinner, he has simply to press a foot stool button, when it would become electrically heated in a short time. It was explained that electrical heaters were used throughout the dwelling and controlled by means of automatic thermostats placed in the various halls and apartments.

From what I had already seen, I was more than anxious to see the processes of the culinary department and so my host conducted me to the kitchen below. It was quite obvious, upon my entrance, that no coal or ashes were used here. Electricity

(*Continued on page 449*)

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain* THE ELECTRICAL EXPERIMENTER, *we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

When the Engineers Go to War

THE engineer in time of war, no less than in time of peace, is always in a position to accomplish some valuable work for his country. Unlike the soldier of ordinary attainments, it is possible for the technically trained man to be of inestimable assistance to the general staff of the Army and Navy, who are responsible for the defense of the country at all times. It is only in the past year that due recognition has been given to technical experts in all branches of applied science throughout the country to show what they really can accomplish in a military way.

One of the most important innovations ever made in this direction was that by Secretary Daniels of the Navy, incorporating the new Naval Advisory Board. All of the leading engineering societies in the United States were asked to co-operate in selecting suitable members for this Advisory Board, with the consequence that we now have a unified staff of technicians, capable of giving thoroughly satisfactory and expert opinions on any electrical, civil or mechanical problem that may arise in the development of new war machinery.

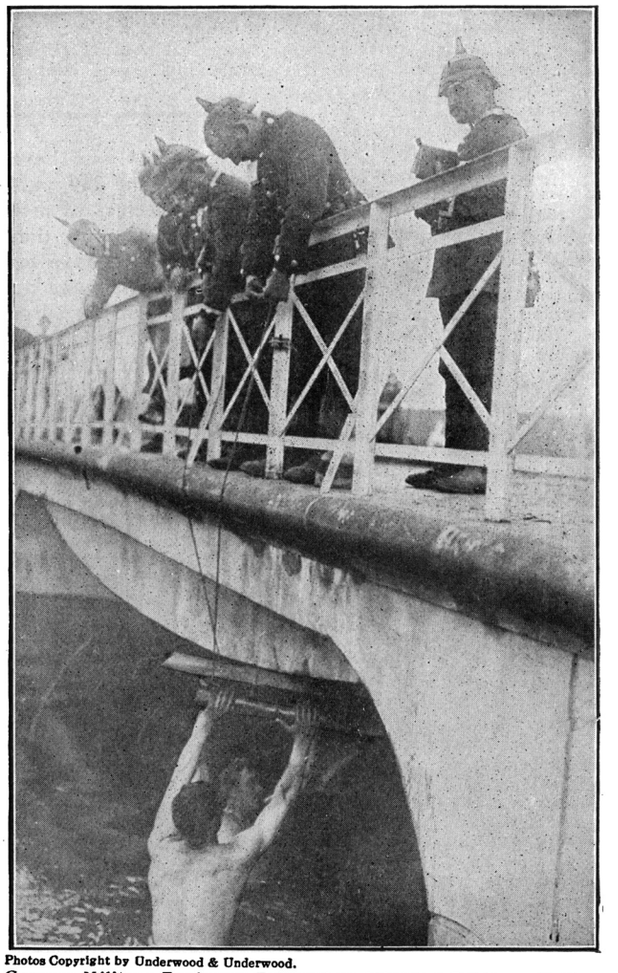
There has recently been organized a complete staff of civilian engineers throughout the country who are assigned to the preparation of *purchasing schedules,* to be used in time of military stress. These concern the details of purchasing military supplies, the cost and time of delivery. Thus it is seen that the civilian engineer may be of great value to the country, without being obligated in any way, as far as military connection is concerned.

On the other hand, we have the professional military engineers, which include men who have climbed up to various high positions, particularly those graduated from the government naval and army schools. The naval experts are graduated from the U.S. Naval Academy, at Annapolis, Md., while the army military engineers graduate from the excellent school at West Point, on the Hudson. This school is one of the best in the world, and has received high commendation from the greatest military experts of Europe, who have happened to visit this interesting institution.

The U.S. Military Academy at West Point gathers its students from all over the United States and its possessions, under the following rules and requirements:

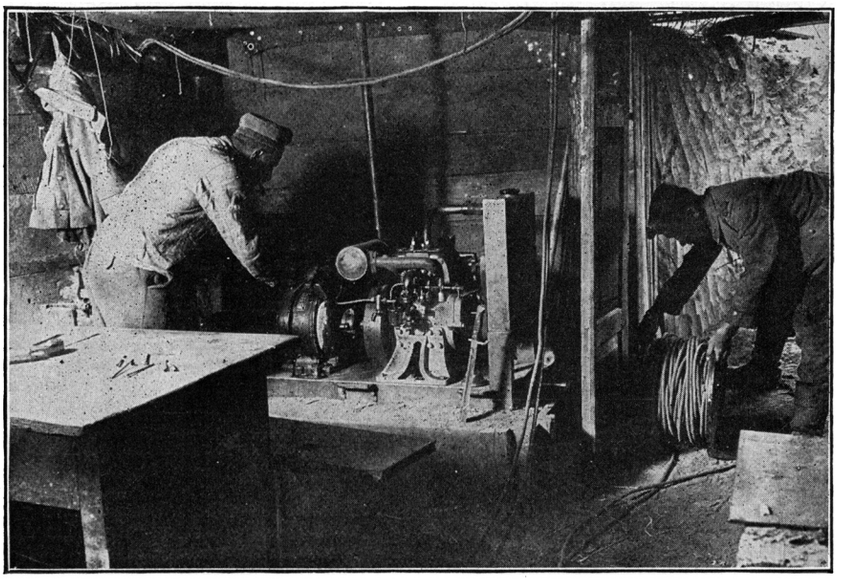
Each Senator, Congressional District and Territory, including Porto Rico, Alaska and Hawaii, is entitled to have one cadet at the academy; the District of Columbia, two cadets. There are also forty appointments at large, specially conferred by the President of the United States. The law (act of March 4, 1915) provides that until the appointment of Representatives in Congress among the several States under the Fourteenth Census of the United States becomes effective (March 4, 1923), whenever any cadet shall have finished three years of his course at the academy his successor may be admitted.

Appointments are usually made one year in advance of admission, by the Secretary of War, upon the nomination of the Senator or Representative. These nominations may either be made after competitive examination or given direct, at the option of the Representative. The Representative may nominate two legally qualified second candidates, to be designated first and second alternates. The alternates will receive from the War Department a letter of appointment, and will be examined with the regular appointee, and the better qualified will be admitted to the academy in the event of the failure of the principal to pass the prescribed preliminary examinations. Appointees to the Military Academy must be between seventeen and twenty-two years of age, free from any infirmity which may render them unfit for military service, and able to pass, unless a satisfactory certificate is submitted, a careful examination in English grammar, English composition, English literature, algebra through quadratic equations, plane geometry, descriptive geography and the elements of physical geography, especially the geography of the United States, United States history, the outlines of general history. The Secretary of War is authorized to permit not exceeding four Filipinos, to be designated, one for each class, by the Philippine Commission, to receive instruction at the United States Military Academy at West Point; *Provided* That the Filipinos undergoing instruction shall receive the same pay, allowances and emoluments as are authorized by law for cadets at the Military Academy appointed from the United States, to be paid out of the same appropriations: *And provided further,* That said Filipinos undergoing instruction on graduation shall be eligible only to commissions in the Philippine Scouts;



Photos Copyright by Underwood & Underwood.

German Military Engineers Engaged in Mining a Bridge. At the Push of an Electric Button This Mighty Structure Will Be Blown to Atoms.



Another Phase of Military Engineering—A Trench Electric Generating Plant, Many of Which Are Near the Firing Line.

serve for eight years, unless sooner discharged.

The course of instruction, which is quite thorough, requires four years, and is largely mathematical and professional. The principal subjects taught are mathematics, English, French, drawing, drill regulations of all arms of the service, natural and experimental philosophy, chemistry, chemical physics, mineralogy, geology, electricity, history, international, constitutional, and military law, Spanish, civil and military engineering, art and science of war, and ordnance and gunnery. About one-fourth of those appointed usually fail to pass the preliminary examinations, and but little over one-half the remainder are finally graduated. The discipline is very strict—even more so than in the army—and the enforcement of penalties for offences is inflexible rather than severe. Academic duties begin September 1 and continue until June 4. Examinations for cadets not having made satisfactory progress in studies are held in each December and June, and cadets found proficient in studies and correct in conduct are given the particular standing in their class to which their merits entitle them.

From about the middle of June to the end of August cadets live in camp, engaged only in military duties and receiving practical military instruction. Cadets are allowed but one leave of absence during the four years' course, and this is granted at the expiration of the first two years. The pay of a cadet is $709.50 per year, and, with proper economy, is sufficient for his support.

Upon graduating, cadets are commissioned as Second Lieutenants in the United States Army. The whole number of graduates from 1802 to 1915, inclusive, has been 5,476. It is virtually absolutely necessary for a person seeking an appointment to apply to his Senator or Member of Congress. The Superintendent is Colonel Clarence Page Townsley, Coast Artillery Corps, U. S.A., and the military and academic staff consists of 134 persons.

(*Continued on page 450*)

Electrical Frauds

By H. Gernsback

EVER since the advent of static electricity in the Seventeenth Century, the public has been made to believe by irresponsible *pseudo* scientists, that the mystic fluid was to be the cure-all for every disease and every ailment of a long-suffering humanity. Not that the early form of static machine had not certain therapeutic qualities. It had, and so has the modern static machine now in use by thousands of reputable physicians. Static electricity as applied to a patient by a physician will greatly stimulate the nerve centers and it is particularly efficacious in the treatment of neurasthenia and neuralgia, as well as certain forms of rheumatism, etc. A *cure,* however, is rarely effected.

When galvanic electricity was discovered in the early part of the Nineteenth Century, the public was still further aroused as to the curative value of modern electricity and magnetism and it did not take long for the unscrupulous quacks to find out that here was indeed a gold mine to be extracted from the unsuspecting, suffering public.

We have no desire to condemn the medical coil, the modern high frequency apparatus, nor the faradic current devices, all of which have therapeutic value and while perhaps seldom effecting cures, nearly always bring relief to the patient if used intelligently.

We do, however, condemn the use of a certain class of devices foisted upon the unsuspecting, devices for which the most preposterous claims are being made. It is true that such devices are perhaps not so widely sold nowadays as two or three decades ago, as they can no longer be advertised in respectable publications. Notwithstanding this, it has been a constant source of wonder to us how much of this material is still being sold every day throughout the world, particularly in the United States A visit to certain second-rate drug stores and certain questionable stores selling trusses, belts and the like, will be a revelation to the man who thinks the entire world enlightened.

And we do not even put the entire blame on these particular store keepers. Most of them probably are laymen themselves as far as electricity is concerned, and a few perhaps believe that the devices which they sell will do what the manufacturers claim for them. So why not sell them? The others who really know, realize that the articles will not hurt anyone and to square themselves with their conscience, assume the attitude of *benevolent auto-suggestion.* They know that many ills have been cured by sugar-coated bread pills! If only the wearer of the appliance *thinks* that it will help him, it probably *will* do him or her some good. So why worry, as long as there is no law forbidding the questionable traffic?

Perhaps the most widely advertised electrical frauds were the "electric" belt, as shown in our figure 1 and the "electrical" trusses and arch supporters shown in figure 2. The cruder form of these devices usually have small round copper and zinc (or copper and silver) plates attached to the inside of the belt which are supposed to lay flat against the skin of either the abdomen or the back, or both. The perspiration of the skin is supposed to act as energizing fluid (electrolyte) and thus is supposed to close the current, as the copper discs are connected to the zinc or silver discs by a wire in the inside of the belt. A formidable current is thus guaranteed to be set up between the discs which, amongst others, will cure the following, taken from the manufacturer's pamphlet: rheumatism, neuralgia, liver and kidney troubles, lumbago, constipation, piles, lame back, poor circulation, nervous, restless nights, incipient paralysis, numbness, prickly sensation, dizziness, tired feeling in the morning, indigestion, weakness and general debility, fits, costiveness, indigestion, spinal weakness, lack of vital force, decay in old or young, all cases where there is a lack of animal electricity. It is a pity that the manufacturers did not include in the list compound fracture of the skull! It is so complete otherwise!

Few people who have a knowledge of electricity would think it possible that the lay public at large is still being exploited day after day, with the class of merchandise described in this article.

Perhaps you think that "electric" belts, magnetic finger rings, "electric" insoles, etc., have long ago disappeared from the surface of the earth. If that is your opinion look around in your town, in certain stores. You will be surprised at the result.

Although this is the Twentieth Century, "there is one born every minute," even in this enlightened age. P. T. Barnum was right: The people want to be fooled!

Now, of course, every student of electricity knows that the current that can be set up between a copper and zinc or a copper and silver disc, using a weak acid (perspiration) as an electrolyte, will never be much above three-fourths of a volt. The current is probably never more than one-fourth ampere in the best of these belts. Now, if this current was steady the belt would at least produce an uninterrupted flow of electricity. Unhappily, due to what is known as polarization, the current in less than one minute drops to almost zero and the "electrical" belt, as far as electricity is concerned, might as well be a plain leather belt; the latter gives almost as much electricity and costs less.

More discs of course do not help generating more current. Thus the "electrical" truss shown in figure 2 gives actually *less* current, though it has several copper and several zinc discs. The idiocity of this construction is particularly violent. Here one copper disc touches a zinc disc, the latter then touches a copper disc and this again touches a zinc disc, etc., etc. Now as soon as the perspiration of the foot touches these plates (the entire surface of the foot being a conductor, due to the perspiration) *all* the discs are, of course, short-circuited immediately! There may be set up a *momentary* current in the thin film of the perspiration, but it never will enter the foot itself. As for curing cold feet and rheumatism, an ordinary sock or stocking is just as efficacious!

Then there is the more pretentious "electric" belt having "batteries" stowed away in its lining. These batteries are again the copper-disc, zinc-disc variety, with felt pieces between the discs. The cells are connected in series by wires. The whole battery is dipped in weak sulphuric acid and is guaranteed to give a powerful current, curing all sorts of ills. This belt as far as electricity goes, works the same as the one described already. No zinc-copper or zinc-silver battery, moistened with a weak acid can give a steady current. The voltage drops in all cases to almost zero in less than one minute. The longer the belt is used the worse it gets and the only powerful act it does is that the acid occasionally burns holes in the underwear and clothing!

The "electric" chest pad, figure 3, is in the same category as the "electric" belts. It is greatly to be recommended for soldiers in the trenches, where it might stop a weak-minded bullet, but as far as electricity is concerned its functions are nil!

The "electric" hair pad, shown in figure 4, is another worthy member of the "electric" belt and insole family. The most it will ever do is that it will cause abnormal perspiration of the head, due mainly to a lack of air circulation. For producing headaches it is highly recommended.

Growing hair on a bald head is a fascinating indoor sport. Victims are born by the million and the older and wiser they become the harder they fall for hair "restorers." Electricity, the cure-all, as a matter of course comes willingly to the rescue. Electricity enlivens the dead cells and sneaks around the extinct hair-papilla taking it unawares, so to speak. A luxurious growth of hair is the immediate result! We do not wish to go on record by stating that electricity might not grow hair under favorable circumstances, but we have grave doubts as to whether it is ever the direct cause of actually growing hair.

At any rate we firmly believe that the "electric" hair grower as pictured in figure 5 never grew hair. No, it was not sold in

(Continued on page 453)

WATCH FOR THE NOVEMBER "E.E."

It will usher in the electrical season of 1916-1917 with a wealth of valuable articles of extreme interest to all of our readers. We have in preparation among other things the following:

"Uncle Sam's New Electric Battle Cruiser—A Forty-Mile-Per-Hour, Sixteen-Inch Gun Super-Dreadnaught."
"Tesla's Artificial Lightning."
"The Wonderful Belin System of Transmitting Pictures Over a Telephone Line."
"Long Range Gun Spotting With Aeroplanes and Radio."
"Back in the Palmy Days—When Wireless Was Young." By H. Scott.
"Electricity and Its Use in Treating Infantile Paralysis."
"A Portable Electric Plant Used in Making the Movies."
"Recent Developments in Practical Radio-telephonic Apparatus." By Samuel Cohen.
"The Spark Coil—How It Works and Why."
"Experimental Chemistry Course." By Albert W. Wilsdon.
"Marvels of Modern Physics." By Rogers D. Rusk, B.Sc.

(For details see text on opposite page)

A Trip Through a Modern Research Laboratory

By Samuel Cohen

THE alchemists for centuries have been laboring in their ill-fitted laboratories to change base metals to gold. To-day this notion is ridiculed, but the laboratories of our modern research workers perform far more wonderful marvels than was ever dreamt by the boldest alchemist. The old chemists left their bottles here and there, tools flung about, with no system whatever. Their only concern was to obtain gold from the baser metals such as lead and iron. To-day, however, the scientific men who are engaged in laboratory work, find it of extreme importance to systematize everything before starting to work and if it is a large laboratory wherein a number of scientists are engaged in research work, they at first cooperate together and classify each certain branch of work that they are to perform; if one of the men is inspired by an idea, the first thing he does is to sketch it out on paper. He then gives the plan to a model maker, who produces his model; it is then placed in the hands of the laboratory assistants, who thoroughly try out the device and finally, if it is successful, it is patented and put on the market. In this way inventions can be most successfully developed. There are several such laboratories where the routine of the different scientists is systematized, all of whom work together under a directing staff of able technicians. The author recently made a trip through the Western Electric Company's laboratories, which is perhaps the most completely equipped and most highly systematized laboratory in this country.

The work that this company conducts is mostly in telephony and telegraphy. The laboratory is divided into different departments, several of which will be here described.

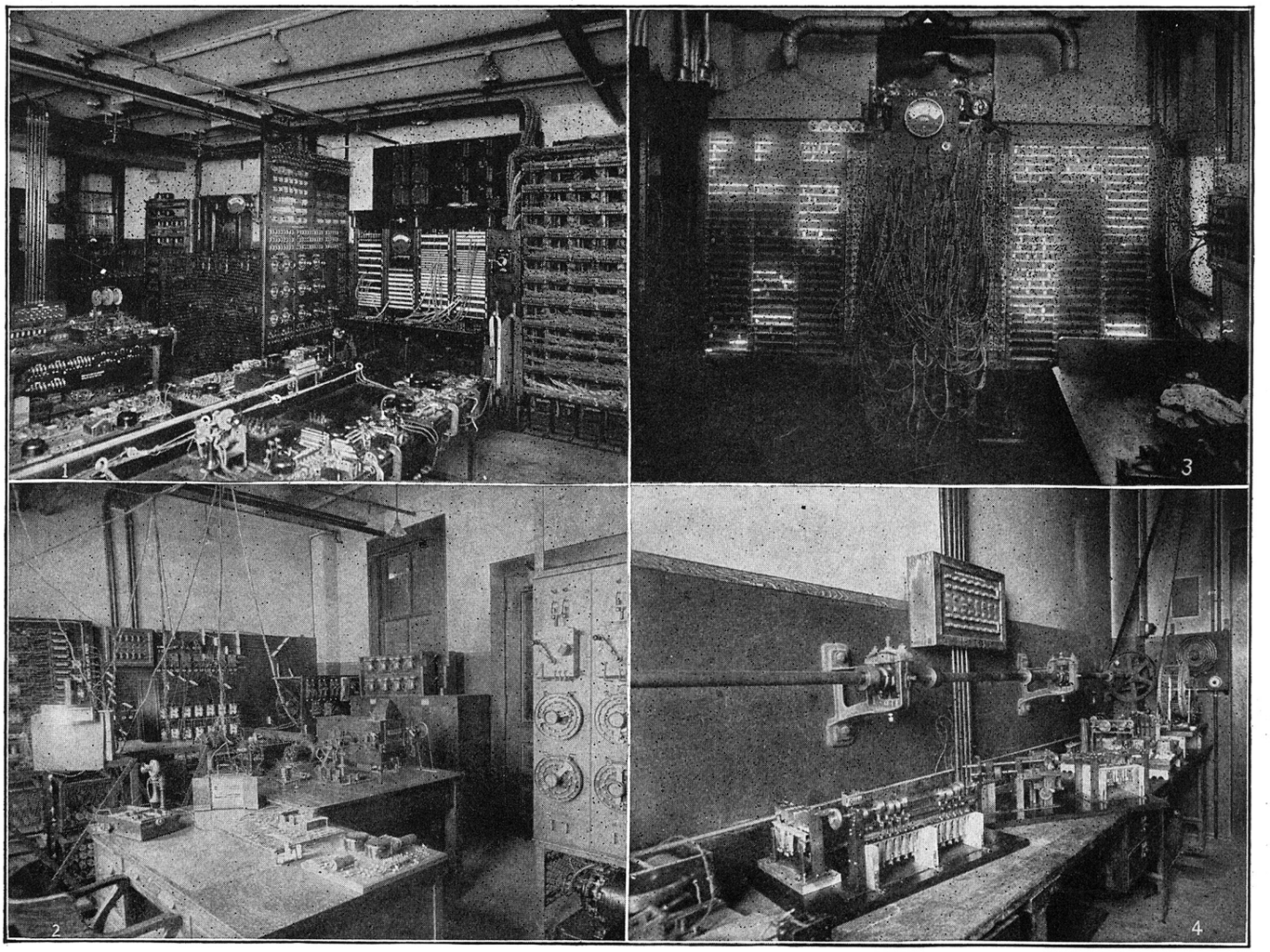
The first department which the author was shown was the research section. Here a large number of scientists work together to develop entirely new apparatus for different lines of work. It was in this section that the wonderful radio telephone apparatus, used in the recent long distance test between Arlington, Hawaii and Paris was developed. It will be of interest to note that several engineers have been employed for a number of years exclusively on radio telephone instruments. In another branch of the engineering laboratories the telegraph typewriter was developed.

We passed on to the circuit laboratory. There were instruments of great variety lying about the different tables, some of which were connected together to correspond to a special problem to which the engineer in charge had been assigned. Thousands of circuit combinations are tested here and new experimental circuits are actually set up and operated to determine their adaptability to the requirements of practical work. Fig. 1 shows a corner of the circuit laboratory. The testing switchboard, in the rear of the room, is so connected that it contains all of the commonly used standard circuits, arranged in such a way that the special circuit under test can be easily connected and operated under actual working conditions. As part of the equipment of the laboratory, artificial lines and cables are provided for the study of long distance transmission.

Then came the refrigerating plant, where materials are tested under very low temperatures and their physical properties studied. In another room are located the high temperature furnaces, in which metals and other substances can be raised to about 3,000 degrees Fahrenheit. Such extremities of heat are at times required to disassociate compounds, into their constituent parts, or else to enhance certain properties of two or more substances so as to make them combine.

The next room inspected was the telephone transmitter laboratory. In this department every new carbon grain transmitter that is being developed and made is thoroughly tested. Several of them are placed in a group and turned over to an assistant, who is given instructions by the

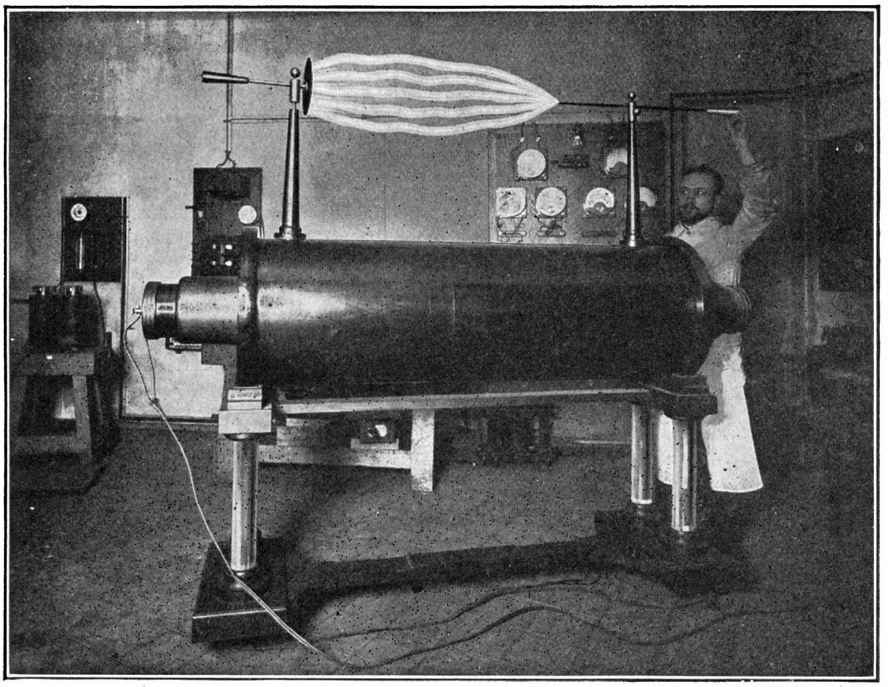
(*Continued on page 451*)



The Expense of Telephone Testing and Research Can Be Judged from the Complex Apparatus Installed in the Laboratories. Only the Great Volume of Telephone Calls Makes Up for the Cost of Perfecting Such a Telephone System as that Extending Over the United States.

GIANT SPARK COIL GIVES 48 INCH DISCHARGE.

A massive spark coil recently constructed in France by the well-known firm of Carpentier, Paris, produced crashing sparks 1¼ meters in length or about 48.75 inches, when operated on a 110 volt D. C. circuit. A mercury interrupter was utilized to break up the primary current of 30 amperes.



Mighty Spark Coil of French Design which Yields Sparks 48 Inches Long. Primary Current of 30 Amperes and 110 Volts, Direct Current was Broken by a Mercury Turbine Interrupter.

The coil proper is supported on glass legs to thoroughly insulate the windings and terminals from ground leakage. The potential of the secondary spark amounts to over a million volts (maximum value). The coil frame is mounted on casters so that it can be moved about at will.

The primary, comprising the laminated iron core and winding, measures 79 inches in length. The core has a cross-section of 60 square centimeters or 9 square inches. The winding consists of 792 turns of wire wound in six sections, the diameter of the wire being No. 18 B. and S. gauge. The primary coil is encompassed by an ebonite (hard rubber) tube 79 inches long by 6/10 inch thickness of wall.

The secondary winding involves the tremendous length of 97½ miles of insulated copper wire No. 32 B. and S. gauge.

CANDLEPOWER OF A FIREFLY'S LIGHT.

Calculating the candle-power of a firefly's light is no easy matter, especially as it shows its brightest light only when in flight; but William H. Pickering of the Harvard Astronomical Station at Mandeville, Jamaica, managed to do it by comparing it with the light of certain stars. The Jamaican firefly gives a brighter light than those with which we in the States are familiar, and Pickering's calculations are for that of the tropical insect. In a recent letter to *Nature* he states that:

"A great number of them fly along a neighboring road, and their position can be determined by their illumination of the inclosing stone walls. Their brightness was found to equal that of the star Canopus, which was just over the road and at rather a low altitude. Its brightness was at that time equal to Orionis, the altitude of which was 40 degrees. It was a very clear evening, as is generally the case here, so that we may take the brightness of the latter as of 1 magnitude. The distance of the road was 175 feet, or 53 meters. A zero magnitude star is equal to one candlepower at 526 meters. If of zero magnitude the light of the firefly would therefore have been just 0.01 of a candlepower. Being of first magnitude, its light was 0.004 candlepower. This result is probably correct within half a magnitude, or 50 per cent, and considering the apparent brilliancy of the insect, is smaller than one would have expected. The writer is not aware of any previous measures of this quantity."

FREAK CAUSES OF TELEGRAPH LINE TROUBLE.

Lineman George Worzel, when stationed at Lackawaxen Pike County, Pa., away back in the olden days, would frequently report the cause of line trouble on his section as due to "bears" breaking through the line on mountain sides, says *Telegraph and Telephone Age*.

Mike Mather, lineman, stationed at Jersey City, N.J., back in the eighties, once reported No. 3 Lackawanna crossed with a German band in Hoboken.

Jim Doyle, lineman, stationed at Fort Lee, N.J., when that place opposite One Hundred and Thirtieth Street, New York, was the Monte Carlo of this continent, would lasso black snakes along the then wild Palisades, throw them across the loop line leading into the horse racing pool rooms, thus causing them to be "crossed out," and after worrying the "bookmakers" for a few minutes, march like a hero to the spot, remove the cause of trouble and collect ten dollars from each of his dupes.

Pete Yensen, stationed at Kansas City, some years back, reported a district call box cut by Carrie Nation's hatchet during one of her raids.

Now Mike Keefe, lineman stationed at Huntington, Ind., reports under date of July fifth, as follows: "No. 257 broke west of Akron, Ind., grounding 262 and 617, caused by a man in a parachute dropping on the line. OK 11:25 a.m." Thus the wire chief's and linemen's worries are constantly multiplying.

THIS BEE DRILLS THROUGH LEAD.

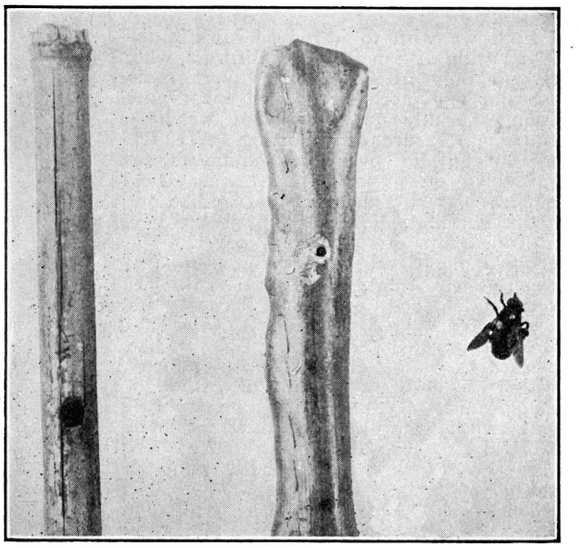
For some years it has been suspected that a sort of beetle was the cause of holes found scraped in the lead sheath of aerial telephone cable in China. But a bee is the culprit, says a writer in the *Western Electric News*. Philip H. Cole, engineer-in-chief of the Shanghai Mutual Telephone Co., China, who visited Hawthorne recently, tells us about this remarkable insect.

It seems that the Wood Cutter Bee uses the bamboo as a place to lay eggs. Her ordinary procedure is to scrape a hole in a living bamboo, crawl inside, lay her eggs and die. The eggs hatch out and the progeny live on the parent's body until strong enough to crawl out and fly away. This bee mistakes the round, smooth, lead sheath of a telephone cable for a bamboo and attempts to follow the same process with it as she does in the case of a living bamboo tree and actually scrapes a hole in the lead sheath. This, of course, lets water in. When she finds that the cable is full of paper and copper, she abandons the job and either scrapes another hole in the lead cable somewhere else or locates a bamboo grove in the neighborhood.

Dr. Cole has observed this insect working both on the cable and on bamboo stalks. He took a specimen of the bee to the North China Branch of the Royal Asiatic Society and that organization gave him the following classification:

"Wood Cutter Bee (Xylocopa Violacea). The insect is a genuine bee, one of the family hymenoptera."

Mr. Cole has observed that where the bamboo groves have been cut away from the neighborhood of the cable that the difficulty has disappeared.



Here is a Real Busy "Bee" That Likes to Scrape Holes Through a Bamboo Stalk so as to Lay Her Eggs Within It. The Bamboo is Seen at the Left But Just See What Her Bee-ship Did to the Lead-covered Telephone Cable at the Center.

The Feminine Wireless Amateur

JUST because a man, Signor Guglielmo Marconi by name, invented commercial wireless telegraphy does not mean for a moment that the fair sex cannot master its mysteries. To prove that the girls and women of the country are rapidly awakening to the fact that radio operating is a worth-while accomplishment, both vocationally and intellectually, we have the pleasure of presenting herewith a number of photographs showing the Radio activities of our fairer sex.

Allow Us to Present Miss Kathleen Parkin, Expert Radio Operator at Fifteen Years of Age. She Has Made Her Own Apparatus.

First we wish to introduce Miss Kathleen Parkin of San Rafael, California, who, though only fifteen, is an expert radio operator and mechanician, and one of the youngest, fully qualified ladies we have had the pleasure of reporting. We felt so enthusiastic over the sentiments set forth in Miss Parkin's interesting communications on the subject that we had our artist reproduce her ladyship at the key, in full colors for our front cover. The original photograph is reproduced on this page. She recently received a first grade commercial radio operator's license from the United States Government. Her call is 6 S O and Miss Parkin says she will be pleased to communicate with any amateur within range. Here is the chance for budding Radio Don Juans to kill a rainy evening, without even getting their feet wet. Bashful amateurs, please take notice!

Miss Parkin writes logically, although she is young in years, to wit:

With reference to my ideas about the wireless profession as a vocation or worthwhile hobby for women, I think wireless telegraphy is a most fascinating study, and one which could very easily be taken up by girls, as it is a great deal more interesting than the telephone and telegraph work, in which so many girls are now employed. I am only fifteen, and I learned the code several years ago, by practising a few minutes each day on a buzzer. I studied a good deal and I found it quite easy to obtain my first grade commercial government license, last April.

It seems to me that every one should at least know the code, as cases might easily arise of a ship in distress, where the operators might be incapacitated, and a knowledge of the code might be the means of saving the ship and the lives of the passengers. But the interest in wireless does not end in the knowledge of the code.

You can gradually learn to make all your own instruments, as I have done with my ¼ kilowatt set.

There is always more ahead of you, as wireless telegraphy is still in its infancy.

Miss Parkin is beginning her third year of high school at the Dominican College, San Rafael, where a small wireless set has been installed for the instruction of the physics class.

Miss Graynella Packer, a young woman of Jacksonville, Fla., whose photograph is shown on the opposite page, has gained for herself the distinction of being the first woman wireless operator to serve aboard a steamship in a commercial capacity. She has served aboard the Clyde liner, *Mohawk,* in full charge of the wireless. She has greater things in mind, however, and it is her ambition to handle atmospheric electricity aboard some of the big ocean liners. Miss Packer was for two years a telegraph operator at Sanford, Florida. She had a number of amusing and unique experiences on various trips along the Atlantic seaboard, including among other things some highly efficient examples of seasickness, the ship rolling about like a nutshell in a washtub, when the vessel endeavored to navigate a heavy storm off the Carolinas. But she stuck to her post, like all good radio operators, and awaited at all times the captain's orders to flash a message via radio.

Wireless telegraphy instruction was a special feature of the work done in a girls' camp at Rowayton-on-the-Sound, Conn., this summer. Mrs. Josephine Craw, of Craw Avenue, Rowayton, gave the use of eighty-eight acres for the camp, which was in charge of Mrs. M. E. Hamilton and which was indorsed by the National Special Aid Society of 259 Fifth Avenue, New York City, where Mrs. Hamilton has headquarters.

There is a demand for women wireless operators, and they are particularly preferred as wireless operators in department stores, where there is an increasing demand for them. The girls at the camp were instructed first by communicating with motor boats on the Sound, and as they became proficient they operated larger apparatus and communicated with regular radio stations.

We show here two views of the women being instructed in military training camps. They were very enthusiastic over the wonders of the radio system and proved adepts at learning the dots and dashes of the Continental code, in which practically all wireless messages are now transmitted and received. Think for a moment of what importance trained women radio operators would be in the event of dire national peril!

It is hopeful that more and more young women will take up the profession each year. There has been an unprecedented demand for radio operators in the past two years, owing largely to the great number enlisted in the American and foreign

Photo, Courtesy of Seven Seas Mag.

Here Are Some of the Patriotic Young Women Studying Radio-telegraphy At One of the Summer Preparedness Camps.

armies and navies. Beside this, there is room right now for women radio experts in many capacities. Owing to the marine laws now in effect calling for two operators on each steamer, and for several other reasons it is self-evident that normally the best chances for women operators will be in land stations

Which brings to mind, among other facts, that of a progressive Boston young lady, who, being a radio operator, found she could not gain a position on a certain ship as two operators were required and one of them was a man! What did she do? Very simple—she married him! Of course this couldn't always happen—far be it from such—but it just shows that—where there's a will there's a way.

When the country-wide call was made recently by the navy department for wireless operators who would be available in time of war the first of sixteen to answer in Duluth, Minn., was Mrs. Otto Redfern, wife of the manager of the Marconi station in that city. Mrs. Redfern is an expert operator and is considering opening a school for women to learn the profession. It seems to be only a matter of time, and a short time at that, before we will have women radio operators as an every day matter of course. We find a fairly good number taking up the studies of wireless telegraphy right now in the principal schools in large cities, particularly New York.

At Boston, Mass., one of the Back Bay society girls who recently attended the "Women's Plattsburg" at Chevy Chase, Md., has just been awarded by the United States Government an amateur wireless operator's license of the first class and is the sixth young woman in the United States to enjoy that distinction.

When she left for the National Service School she took her license along and qualified as a wireless operator in the field.

After studying in a radio school for a short time Miss Baylies appeared at the office of H. C. Gawler, United States radio inspector, in the custom house at Boston, and was put through a two-hour examination. She passed with flying colors. It is said that she obtained a mark of 97 per cent, which has seldom if ever been attained by any male applicant for such a license.

In the test, which was a stiff one, Miss Baylies was compelled to show her knowledge of the Continental Code and afterward drew a diagram and gave an accurate description of an amateur "hook-up." She easily "received" twelve words a minute in the radio code.

Mrs. Alexander MacKenzie, of the New York State Woman's Suffrage party, Yonkers, is the woman who provided material for a very good wireless story several years ago.

Mrs. MacKenzie's son had rigged up a wireless outfit on the roof of her Yonkers home and she learned to send messages and to receive them to a limited extent. During the summer of 1915 she went to the instruments every day at stated hours, morning, noon and night, and flashed out the words—*Votes for women*—400 miles into space. Usually she got replies, sometimes from land wireless stations and sometimes from ships at sea, ranging from "Good for you old lady!" and "We're with you!" to "Oh, piffle!" Then again she assumed to be the Goddess of Liberty, and made quite a wireless "speech" explaining how she had grown old waiting for woman suffrage.

The Yonkers women used wireless in their 24-hour demonstration, election night, last November. They made speeches in Manor House Square and a wireless station above the platform received messages from various celebrities and prominent suffragists. Women radio operators will figure in the adoption of wireless on Hudson River steamers. The Hudson Navigation Company has announced that the *C. W. Morse* and the *Berkshire*, the two largest vessels in the Hudson River passenger trade, have been equipped with Marconi apparatus and that the rest of the company's fleet would be similarly fitted if the new feature proves successful.

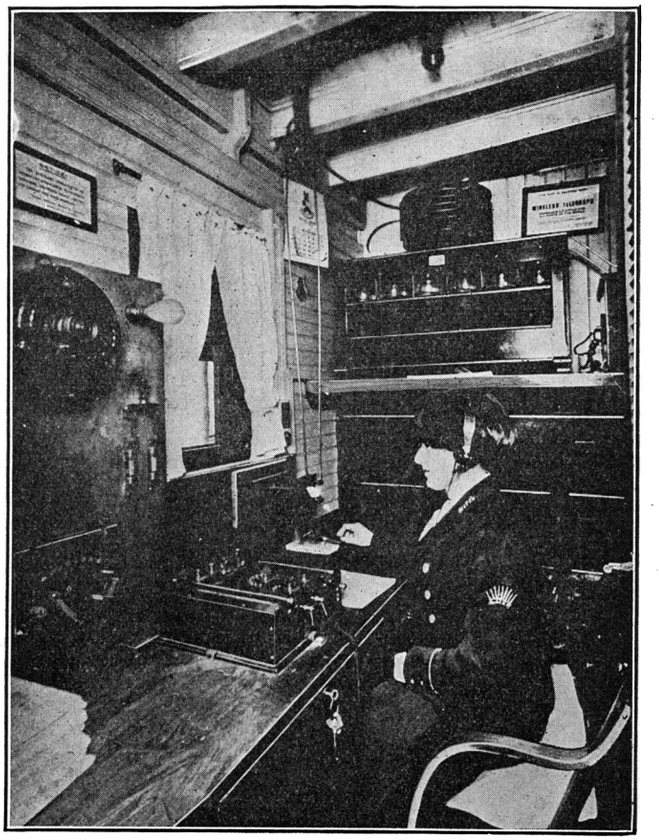


Photo Copyright by Paul Thompson

Miss Graynella Packer, the First Woman to Serve as a Commercial Wireless Operator. She Is Seen Operating the Radio Set on the Clyde Liner "Mohawk."

Land stations have already been installed at New York City, Poughkeepsie and Albany. Women operators, dressed in natty blue uniforms, will do the receiving and sending on the steamers.

Wireless telegraphy as a means of livelihood for women and as a means through which they might actively aid their country in time of war is one of the callings in which the members of the Girls' Division of the United States Junior Naval Reserve are receiving instruction. The girls' division of the Naval Reserve was formed to instruct girls in the importance of a navy and a merchant marine for this country in the expectation that a few years hence, when the teachings have had time to permeate among the girls and young women of the country, it will have a tremendous influence on the adoption of a thorough-going preparedness—military and commercial as well as naval—by the federal government.

The preliminary work of organization of the girls' division has been painstakingly done, and two posts have now been formed. One is the Martha Washington Post, of Edgewater, N.J., and the other the Betsy Ross Post, of Bay Ridge, Brooklyn. These two posts form the nucleus of the Girls' Division of Naval Reservists.

The organizers of the movement have refrained from publicity and soliciting enrollments until they were in position to handle the girls who volunteer. They are now in such condition, and the organiza-

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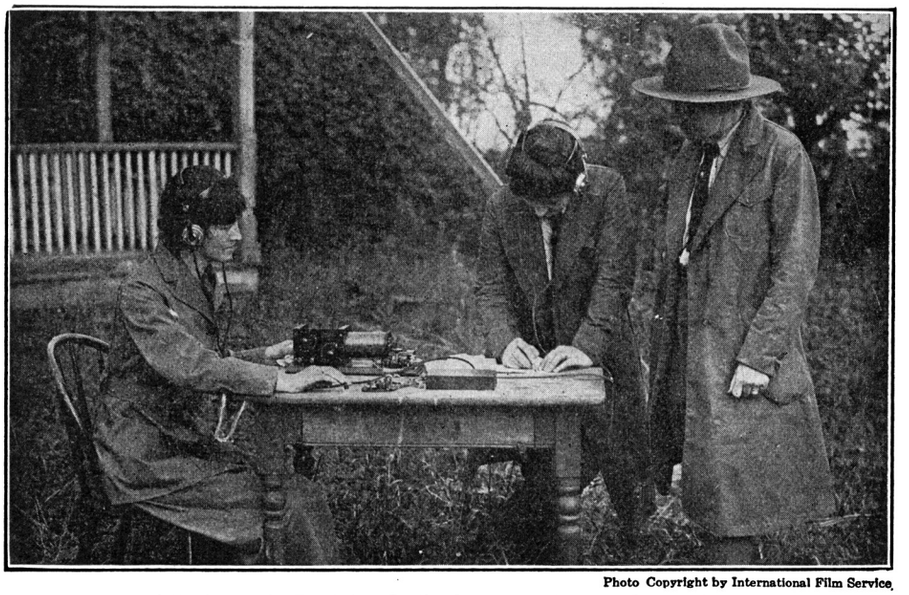


Photo Copyright by International Film Service

Another Group of Enthusiastic Feminine Radio Operators Copying Down the Messages as They Arrive. A Preparedness Move in the Right Direction.

How the Farmer Uses Electricity

By H. Winfield Secor

POSSIBLY you were not raised on a farm, and then again perhaps you were. At any rate you and I have, away down in our hearts, always cherished a deadly antipathy for anything that resembled farm work, i.e., real farm work, the kind where you rise with the sun, milk the cows, feed the pigs and horses, saw a cord or so of wood, and then hie yourself with the little brown jug (full of water, to be sure) to the pickle field, there to pick, under a boiling sun, several thousand of Heinz's toothsome delicacies. Or perchance it was a-haying we went, and some *ticklish,* sweat-producing task it was too. And didn't we like to churn the butter with one of those high-speed, vertical, reciprocating types of churns so dear to our forefathers; yes we did *not,* and never will. But some one must cultivate the soil and make the butter or else we couldn't live.

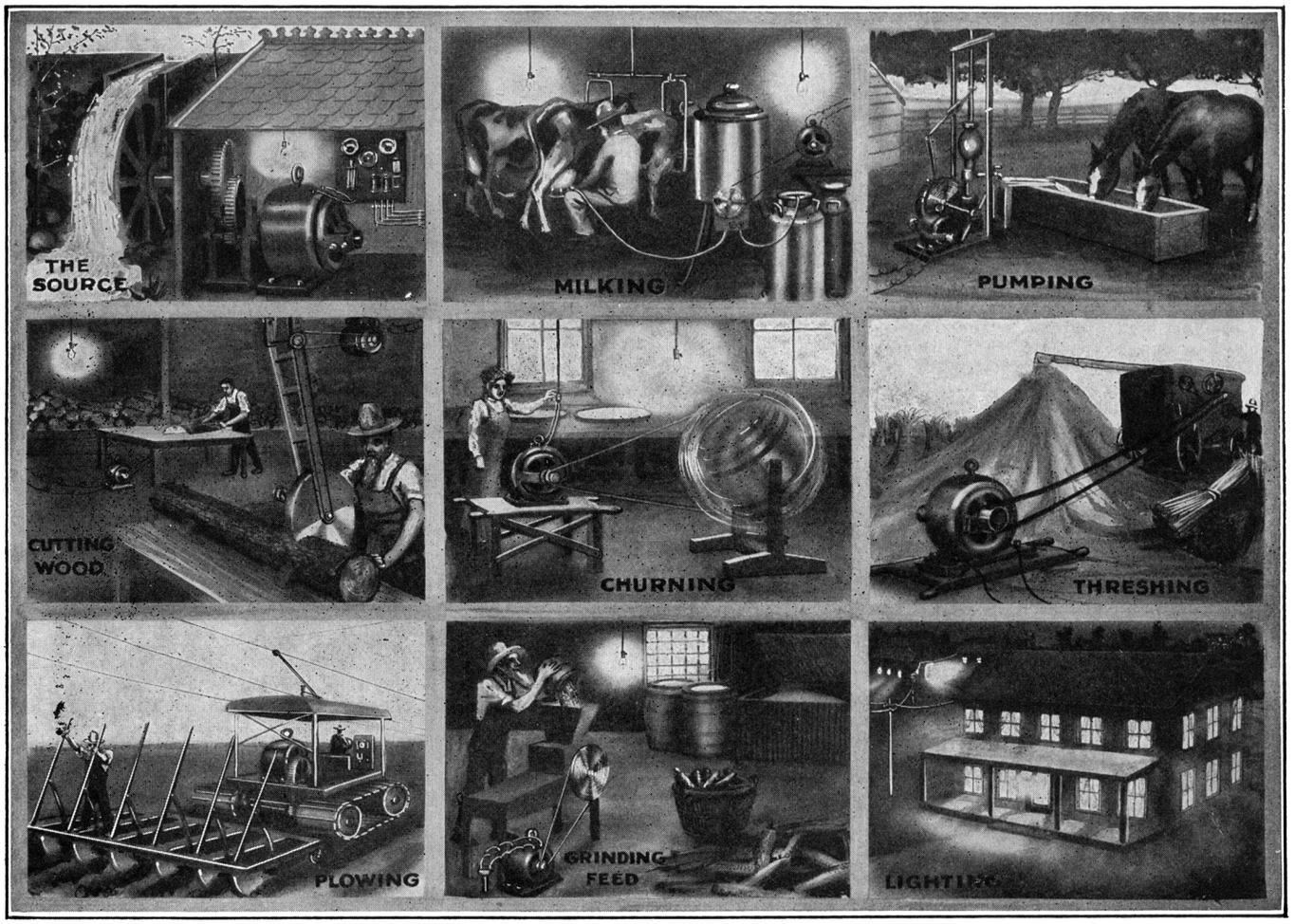
That wonderful genii, *Electricity,* in his myriad moods and phases, has come at last to the farmers' aid. The adoption of electrical devices on eastern American farms has not begun to reach the magnitude of that attained in the western section. It is often the case that the progressive, wide-awake farmer can utilize some natural source of power for the production of his own electric current. A waterfall, for instance, is generally available for driving a turbine or wheel, which in turn may drive a dynamo. The current is easily lead from the dynamo to any point about the farm. A portable electric motor transforms the electric current into mechanical energy suitable for driving a threshing machine or any other mechanism if it is properly rigged up.

An electrically-driven, vacuum milking machine is a necessary adjunct of every up-to-date farm, especially where there are above a dozen cows or so. It will enable one man to milk a number of cows simultaneously, while he could only milk one cow at a time by hand. The modern improved form of vacuum milker is a marvel of simplicity and efficiency. When these new-fangled electrical *milk-suckers* first appeared, the farmer called them down long, loud and lustily. They'd ruin his cows, surer than Satan. They worked too quick and too steadily to suit the farmer, and by-gosh he was right. Most of them landed in the barn-yard scrap-heap. The up-shot of it was that finally the right man came along, studied the cow as well as the milking machine, and proceeded to evolve a modification of the apparatus which would have some mercy on the animal, while realizing a higher efficiency than hand milking.

The machine milker of 1916 vintage is a wonderful contraption. It is successfully used now by the largest milk and butter dairies in the country, where hundreds of cows are milked every day. The secret lies in the fact that instead of creating a steady drain on the cow's udder, or a strain on all the nipples periodically, the milk is now sucked out intermittently, and successively, first from nipple No. 1, then nipple No. 2, and so on, in the order of 1—2—3—4, then 1—2, etc., over again. Moreover, the degree of the vacuum may be accurately adjusted for any animal. Some cows, of course, require a slightly different treatment than others. It is a wonderful sight to see long rows of cows being milked by these machines, the animals standing contentedly and chewing their cud, as if nothing on earth bothered them.

Pumping is one of the hardest jobs on most farms. Some use wind-mills, but the majority of progressive farmers have adopted an electrically driven pump, even though they buy their current from the local electric light company. It is always on the job, while the wind-mill likes to loaf for days at a stretch, sometimes.

Motor-driven buzz saws are a great boon to the wood chopper. With current distributed all over the farm, it is an easy matter, with a portable motor, to cut up cord wood or logs at any point desired. Besides trees are felled very readily by special apparatus adapted to be driven by electric motors. In one of these schemes the motor drives a fine steel wire at high speed, the wire encircling the tree trunk, and the heat generated in the wood causes



Here We See How the Up-to-date and Progressive Farmer Makes Use of Electricity. Electric Motors Soon Pay for Themselves on the Farm in the Time Saved, and the Electric Lights are not a Luxury, but a Positive Necessity, Where Efficiency is the Watchword.

the wire to gradually eat (or char) its way through.

Electric motors fitted in wagons and rated at 5 to 10 horsepower or more are widely used, especially in Europe, for driving threshing and kindred machines. In some instances a farmer owning a threshing machine and portable electric motor manages to make good profits by doing this work for other farmers in his locality, obtaining current for operating the motor either from private service lines on the farm where he does the work, or from commercial or state owned industrial service lines, as is the case in many parts of Germany and England.

In the operations of aereating milk, cream separating and butter churning, the small electric motor comes in as a safe, efficient and readily attached source of motive power. By simply connecting a rheostat or adjustable resistance in series with the motor, its speed can be varied at will. Anyone, from the child of ten years, to the green-horn just over from Poland, can turn on a switch. Electricity is the simplest form of energy to handle, beyond a doubt, and this is one of the principal reasons why it is so attractive to the average farmer. He knows that if he buys a gasoline engine (they all go when you first buy them), that sooner or later he must become a specialist in the various whims and caprices of the carburator, the ignition spark coil and a thousand other devilish, consarned contraptions.

Electrically-operated gang plows have been tried out and have considerable promise. At first thought it may not seem feasible, owing to the vast amount of trolley wires required over a large farm of say several hundred acres. However, it should be borne in mind that modern gang plows often cut a swath up to 20 feet wide. Hence trolley wires 20 feet apart would suffice, and with about a dozen trolley wires on hand one or two such gang plows can be kept going easily; the wires being unhooked at either end of the span and moved to a new position as the plowman progresses. After he has finished the first course, the No. 1 trolley wire is taken down and re-erected after the 12th wire, etc. A switch is best placed on each pole so that the wires can be cut off from the supply feed wire before they are handled.

Around the barn and corn crib the electric motor proves particularly efficacious. It grinds the corn for the chickens, grinds feed for the cows and horses, and performs the dozen and one other things which must be done on the farm, especially about the barns and out-buildings.

Then there is the ever-present problem of artificial light for both house and barn. The oil lantern is rapidly disappearing, owing to the cheapness and other meritorious features of electric lighting. And oil lamps for illuminating the living-rooms —abominable you say. Not only are they a poor source of illumination, i.e., low in candlepower, but they are distinctly dangerous and a constant fire hazard, as insurance statistics prove. To the farmer, the electric light is a blessing in disguise, perhaps, but no less a one than it is to his city cousins. Electric light to him is actually a necessity in many ways, as for instance, where milk is being handled. Lanterns have often been kicked over by a rebellious cow, with a burned down barn as the result. In fact this identical accident is said to have been the cause of the terrible Chicago conflagration of some forty years ago, which created ruin and destruction to the extent of millions of dollars. Properly installed, electric light wiring is no more liable to short-circuit or become defective than other lighting systems. It is certainly far better in this respect than either gas, acetylene, or oil.

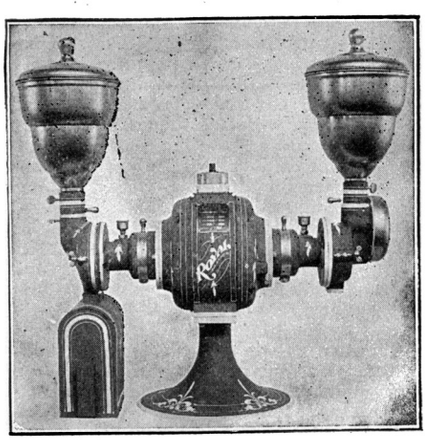
It has been proven that invariably the installation of electric lights pays for itself many times over, no matter whether the current is generated on the premises or purchased from the electric company. There are many reasons why this is so, particularly those involving the effect of light upon certain animals, and especially on chickens, it is said. Besides the farmer cannot help but enjoy his surroundings much better when they are artistically and correctly illuminated. His house is a dozen times more hospitable, and a fine advertisement to burglars and chicken thieves to *keep away!* When he hears a noise, even out in the barn, he can push a button and flood the outlying buildings with light, as also the yard. Three-way switches are often installed, so if Mr. Prowler switches off the lights from his end of the circuit, the owner can simply push another button on the same plate and flash them on again. The thief hates light and the wise suburbanite or farmer is rapidly waking up to this fact.

A number of interesting facts were cited recently by Mr. W. T. Kerr, city electrical engineer of Hereford, England, who urged that greater attention should be given to the use of electricity in farming in England by electric supply authorities, engineers and manufacturers. In Germany and France official recognition had been given to the utility of numerous agricul-

(*Continued on page 452*)

PEANUT BUTTER WHILE YOU WAIT.

The accompanying illustration shows a peanut butter machine combined with a steel cutting, electric coffee mill, the peanut



This Electric Machine Makes Peanut Butter While You Wait.

butter attachment being the one which does not show a receiving can underneath.

The peanut butter machine as a separate outfit is equipped with either ⅓ or ½ H.P. motor for direct or alternating current, and is capable of making from ½ to ¾ pounds per minute or 30 to 45 pounds per hour of peanut butter, which meets with a ready sale, because it is more appetizing and nutritious than peanut butter purchased ready packed in jars or tins.

The peanuts are reduced by means of steel buhrs, similar to those used in the pulverizing parts of electric coffee mills, being fed into the buhrs uniformly and at proper speed by an arrangement of rolls contained within the grinder head.

WOMEN TEND DYNAMOS IN ENGLAND.

Owing to the war conditions, girls are used as attendants in the sub-stations of Glasgow, Scotland, where they attend to the 500 K.W. rotary converter units with great success, says *Electrical Engineering*, London. The women are trained first for three weeks at the head office and then sent for a further three weeks to the substation before they are considered sufficiently proficient to take charge. The wages are $5.25 per week while under training, and $6.75 per week on attaining proficiency. They are engaged for a week of fifty-four hours, but the actual average hours per week is only fifty-one. Nine women are up to the present employed at four substations in all, and in addition there are three at the Port-Dundas power station, taking instrument readings, keeping records, and generally doing the work hitherto done by the fourth engineers.

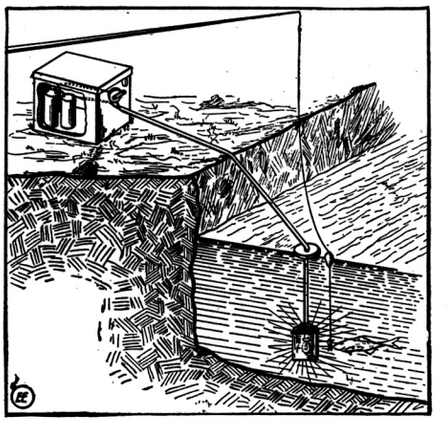
ELECTRIC LIGHT CAUSES FISH TO BITE.

By George C. Denny.

Luring fish by electricity is simply a new and very efficient stunt to which a few batteries and an electric light may be applied. In a recent patent for this purpose an inventor has provided a device which is intended to induce timid fish to venture from their hiding places in drifts, into the open water, where they may be easily caught by the patient and persistent fisherman.

The device consists merely of an electric lamp incased in a strong glass container, a float to regulate the depth of the glass, a coil of wire, and a few batteries to energize the lamp. The wires are insulated from the water by a length of rubber tubing and the batteries stored in a portable box on shore. The flexibility of the tubing, however, does not permit it to bend under the stress of flowing water. A small switch mounted on the outside of the box completes or opens the circuit to the lamp at will.

When the fisherman is ready for operations he sets his float at the proper place and drops the lamp into the water. He then allows his line to hang alongside the lamp and proceeds to make himself comfortable. The fish soon crowd around to view the electrical display and when one attempts to relieve the hook of its bait, the angler pulls him in. After all of the fish at one place have been drawn from their hiding places. the fisherman turns off his light and draws it shoreward. The tubing is now coiled and placed with the lamp and float in the box containing the batteries and, picking up



Now We Have an Electric Lure for Fish in the Form of a Small Electric Lamp Placed Close to the Hook.

his box and fishing tackle, the merry angler proceeds to invade another choice spot where the fish have as yet not been introduced to the wonders of electricity.

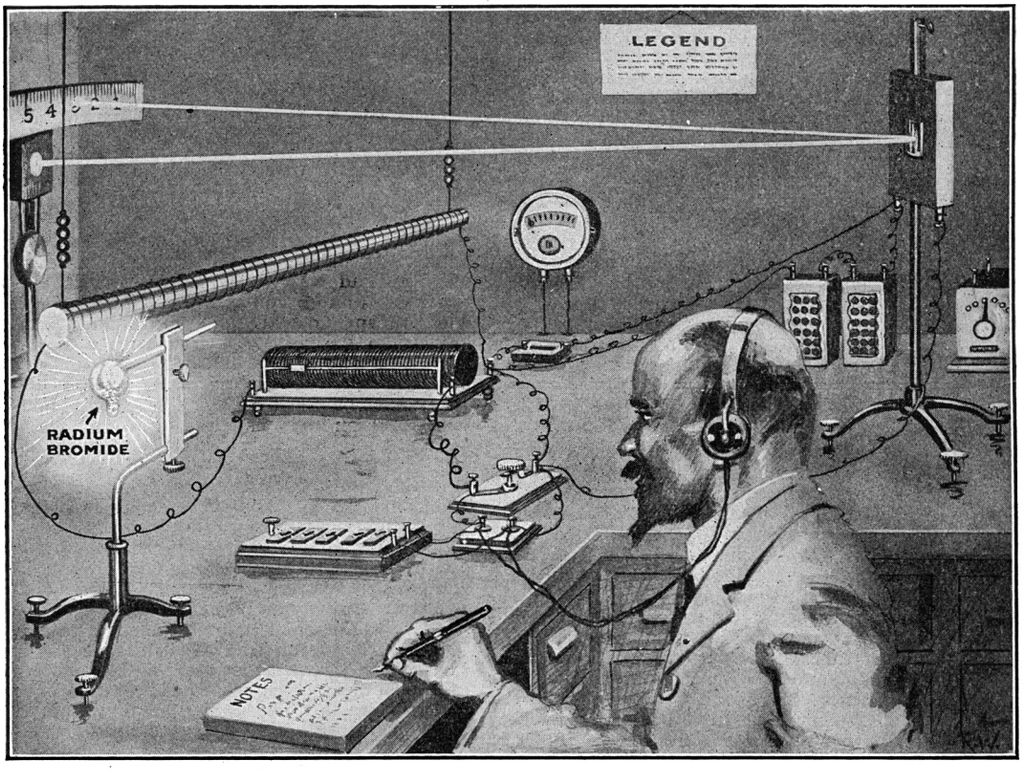
Intensifying Radio Signals with Radium

SOME most interesting facts regarding the effects of Radium on wireless telegraph receiving apparatus have been given recently by E. Bemier, a German scientist.

On the results of Szilard with radium-coated lightning conductors becoming known to the author he was led to consider the possibility that radium might exert some effect upon the reception of radio-telegraphic signals. The first tentative experiments seemed to give evidence of positive effects; but as the author was obliged to discontinue them in consequence of the world war he now publishes his results with a view to stimulating further research and also obtaining independent confirmation of his own conclusions.

The first experiments were made with an indoor antenna consisting of a wood rod loosely wound throughout its length with wire, the rod being directed towards a sending station, FL, about 300 kilometers distant from it. This antenna was suspended in a room as the illustration shows. The receiving set used comprised a galena detector, 4000 ohm telephones, and a tuning coil having 800 turns of enameled wire. No signals were audible from FL at any position on the tuning coil. Signals were, however, at once distinctly audible as soon as a sealed glass tube containing radium bromide of 50,000 units (and thus very weak) was brought near. The signals vanished when the shunt resistance was 220 ohms, using the shunted telephone method. The tuning was not at all sharp, and showed no maximum for any length of included wire between 80 and 120 meters. A change in the position of the radium did not produce any noticeable differences; but the orientation has a marked effect. At certain wide angles the reception ceased entirely.

Mr. Bemier, encouraged by these results, continued his investigations in order to determine the effect of radium on an ordinary antenna. The antenna consisted of two parallel 1.5 mm. phosphor-bronze wires held 1 meter apart and 8 meters above the ground, directed towards the station FL, as was also the connection to the receiving set. For this latter the same tuning coil was employed; but an electrolytic replaced the galena detector, and in place of the telephones a special moving-coil, reflecting mirror galvanometer, of 500 ohms resistance and period two seconds, was used. The signals utilized were the 10-second time signals from FL. With the best tuning and 56 meters the telephones gave 80 ohms for silence; the galvanometer showed 20-21 microamperes (one microampere is the one millionth part of an ampere). With the antenna disconnected the current through the detector was 0.7 microampere.



A German Investigator Has Discovered That if a Tube Containing Radium Bromide Is Brought Near a Wireless Aerial, the Strength of Signals Will Be Intensified. A Coil Antenna Was Used as Shown.

On the radium tube being brought near to the free end of the antenna the galvanometer reading was 50-53 microamperes; to reach this maximum the tuner had to be shifted from 56 to 48 meters. In this position the reception without radium was quite as mistuned as it was in the 56 meter position with radium. When the radium was fastened at the mid-point of the antenna no reception was possible, even with the telephones. With the radium arranged at the connected end of the antenna the current through the detector increased to 35-38 microamperes at the 40-meter tuner position. All the results have been definitely confirmed as a result of numerous control experiments, made under conditions as nearly similar as possible.

These experiments show that by suitably bringing up radium in proximity to the antenna the vibration image of the latter is changed in the direction of an apparent shortening of the wave; further, that a considerable increase in signal strength, as measured in the detector circuit, is occasioned by the proximity of radium, which must in any case be caused by a higher received primary current.

The proximity of radium to the tuning coil itself has, however, the effect of rendering distinctly worse the previously distinct telephonic reception, without it being possible to discern any definite mistuning, and this applies whether the radium tube be insulated or earthed. On the other hand, the radium tube exerted no noticeable effect on any of the other parts of the receiving equipment.

HUMIDITY AND THE STATIC MACHINE.

It is often said that static machines cannot be used successfully in humid weather. This is the experience of those only who do not understand the care of the static machine, for there is no climate on earth where a static machine cannot be used with more or less efficiency if proper care is taken to keep the interior of the tightly closed case dry, says the Editor of the *Journal of Electro-therapeutics and Radiology*. A static machine that is used in a humid climate, however, should be renovated once every year if it receives the usual use of the busy man who recognizes its value; for the nitrous oxides produced within the case are certain to deteriorate some of the metal parts, which if they are relacquered and the glass revolving plates reshellacked, renders the machine in excellent condition against humidity, providing a proper drying material is kept within the case.

Some employ sulphuric acid in a large receptacle, but most observers have found the commercial calcium oxide in hard chunks the most effective means for absorbing the moisture. One mistake made by those who do not perceive the danger of lowering the efficiency through permitting dust to fly into the machine is that the container is not well covered. To place several bags, with one thickness of muslin over them, in a box is not adequate protection against letting the dust out. If this is done and an additional wrapping of good muslin fastened about the whole box and tacked tight in such a manner that the dust cannot escape, it will be well. Otherwise place the lime in a box with slatted sides, which will contain when two-thirds full, forty to sixty pounds of dry lime according to the size of the machine, and cover it over with two thicknesses of the best, finely woven, unbleached muslin tacked in around the edges so that no dust can escape, and it will be all that is required in any climate if changed from once a month to once in two months, to keep the interior of the case in proper condition.

Direct public wireless service connecting Japan with other countries, has been inaugurated between Ochiishi, on the east coast of the Kokkaido, and Petropavlovsk, in Kamchatka, Siberia.

A chain of wireless stations is being erected around the entire coast of Australia so that vessels are never out of communication with shore. These stations also connect with similar stations at New Zealand and Fiji. Soon all the English possessions in the South Sea will be connected by radio.

GEORGE WESTINGHOUSE.
October Marks His 70th Birth Anniversary.

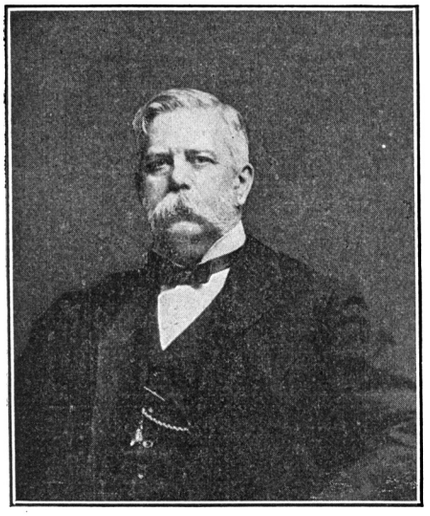
Born, Oct. 6, 1846. Died, March 12, 1914.

George Westinghouse, the world famous inventor of the air brake, died of heart disease at his home in New York City, March 12th, 1914, aged 67 years. Mr. Westinghouse as well as being one of the world's best known inventors was also an electrical and mechanical engineer of the highest standing.

Mr. Westinghouse was born at Central Bridge, Schoharie County, New York, October 6th, 1846. His paternal ancestors came from Germany and settled in Massachusetts and Vermont before the Revolution; his maternal ancestors were Dutch-English. His father was an inventor, who in 1856 removed his family to Schenectady, N.Y., where he established the Schenectady Agricultural Works. Here George attended the public and high schools of the town, spending much of his leisure time after studies in his father's machine shop. Before he was fifteen he had invented and built a rotary engine.

In 1865 Mr. Westinghouse invented a device for replacing railroad cars upon the track which was manufactured for him at Troy, N.Y. He then made attempts to devise an automatic brake for railroad trains, but this was unsuccessful because steam was employed. He then hit upon the use of compressed air and the brake was designed which afterwards completely revolutionized railroad operation the world over. Drawings of an air pump brake cylinder and valves were made, but considerable time elapsed before a practical trial was undertaken. The first patent was issued April 13, 1869. The Westinghouse Air Brake Co., was then formed on July twentieth of the same year and a small factory was built in Pittsburgh in 1870.

In 1886 the Westinghouse Electric Co., was formed for the manufacture of lamps and electric lighting apparatus, Mr. Westinghouse having turned his attention in that direction. The business rapidly developed and in 1889 and 1890 this company absorbed the United States Electric Co., and the Consolidated Electric Light Co. In 1871 all these properties were re-



George Westinghouse, Famous American Engineer and Electrician, Whose Name Is a Household Word Throughout the World. At His Death He Headed a $200,000,000 Electrical Manufacturing Corporation.

organized into the Westinghouse Electric Mfg. Co.

The question of the steam turbine and its application was investigated by Westinghouse and he secured for his company the patent rights of Charles A. Parsons, the famous English engineer, on the turbine in 1897-8. His study of the new prime-mover soon led the inventor to consider its use for ships. He accomplished this work in collaboration with the late Admiral George W. Melville and John H. MacAlpine Wilkin. In the latter years of his career he also occupied himself with the development of air cushioning devices for automobiles and motor trucks. which rapidly came into favor.

He was one of the first to perceive the limits of the direct current system and in 1885 acquired the American rights of Messrs. Gaulard and Gibbs in connection with alternating current distribution. He then gathered about him such shining lights as William Stanley, Nikola Tesla, O. B. Shallenberger and others who contributed not a little to this development. He backed Mr. Tesla with both manufacturing and financial assistance in the development of the induction motor while his foresight in perceiving the advantages of the alternating current transformer for varying pressures has made possible the transmission of energy over vast distances and its utilization at remote points.

Mr. Westinghouse was given the honorary degree of Doctor of Philosophy by Union College in 1890. He was also decorated with the Legion d'Honeur of France, the Royal Crown of Italy, the Grand Cross of Leopold of Belgium and others.

At the time of his death Mr. Westinghouse was president or director of twenty-two companies with works in all parts of the world, there being between thirty-five and forty Westinghouse companies in Europe and America. He employed 50,000 persons and the capital of his company was $200,000,000. The name Westinghouse may be seen on electrical machinery in every quarter of the civilized globe—from the southernmost parts of Africa to the frozen climes of Alaska.

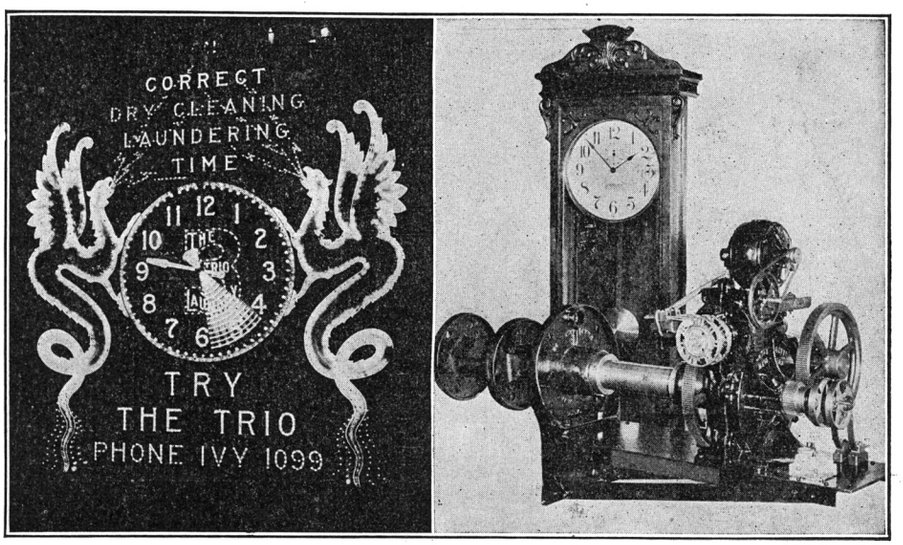
A Mammoth Electric Clock

The accompanying photograph shows a mammoth electric clock recently installed at Atlanta, Ga. The action of the sign is well chosen and attracts a good deal of attention. The flasher starts with the lighting of the ring around the dial of the clock. Next the dragons appear with shimmering wings and tail, spitting flashes of lightning which pass through the lettering on the top. The color of the lightning is amber, while the dragons are outlined with green lights. The following words are flashed in consecutive order:

Correct Laundering
Correct Dry Cleaning
Correct Time.

All these are illuminated with opal lamps.

The figure "3" in red in the center of the clock, also the words "The Trio Laundry" are illuminated and remain constantly lighted. This magnificent and striking sign measures 45 feet high by 33 feet wide and weighs 17 tons. A special steel frame structure was built for it, as it covers the roofs of two buildings. The total number of lamps used on it is 2,000 of the five-watt size.



Novel Electric Clock and Its Master Clock, Also Lamp Controller as Installed at Atlanta, Ga.

The special flasher used in operating this sign is illustrated at the right. The master clock is used for timing the large sign clock. This is done by having contacts on the main clock which operate the motor; the latter, in turn, revolves the clock hands by means of a set of gears as the reader will perceive. The construction of flashers has become an engineering feat in itself as one can see by the manner in which this one was made. *Photo courtesy Betts & Betts.*

WITH THE NOVEMBER ISSUE

we will present a new

SUPPLEMENT

of a famous electrical inventor. This is the first of a series promised to our readers.

These supplements are printed on fine art paper, ready for framing. They are invaluable to adorn your den, your wireless station, or your laboratory.

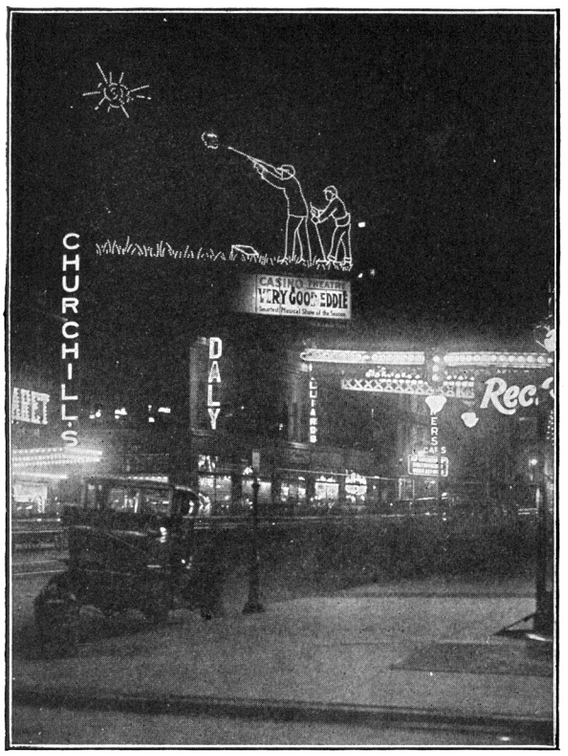
Order your copy now, to make sure you will get it.

ILLUMINATION OF BALBOA COALING PLANT.

Plans are being made for illumination of the mighty cranes at the Balboa coaling plant at the Pacific end of the Panama Canal to the end that they may be worked at night as freely as by day.

WATCH THIS "ELECTRIC SIGN" HUNTER HIT THE BULL'S-EYE.

The electric signs along the Great White Way of New York City are becoming daily more attractive and ingenious it seems. This photo illustrates one of the latest electric signs erected recently at Broadway and Forty-ninth Street. This measures 71 feet 8 inches long by 41 feet 5 inches high and contains 3,500 incandescent lamps.



Every Time This Electric Sign Huntsman Fires His Gun He Is Sure to Hit the Bull's-eye. A Recent New York City Product in Progressive Advertising.

At first a series of words are flashed out; the length of each letter of the various words is different; the largest 8½ feet tall and the smallest 4 feet. When the phrases are distinguished, two men appear, standing in the grass, each leaf of which is caused to wave very realistically by a special flasher operating a certain group of lamps. At the beginning the man at the left holds a gun at his side and in a few seconds he raises the gun to his shoulder and shoots.

The discharge of the bullet and the accompanying effect are apparent from the photograph. As soon as this action is finished, the sign is automatically extinguished and the words "A Sure Hit, Etc.," again appear. This interesting electrical display was built by the *O. J. Gude* concern.

GRAVITATION AND TEMPERATURE.

As the outcome of a very delicate systematic series of experiments it is announced by Dr. P. E. Shaw that "when one large mass attracts a small one the gravitative force between them increases by about 1/500 as temperature of the large mass rises from, say, 15° C. to 215° C."; that is, it increases by about 1.2×10^{-5} of itself per degree Centigrade. This seems to be a very startling result; at any rate if temperature is merely the expression of internal molecular motions, as, indeed, Dr. Shaw seems to admit, says a writer in *Nature*.

By Newton's principle, gravitation between masses must act reciprocally; the result, therefore, means that the astronomical mass of a body must increase with temperature by 1.2×10^{-5} of itself per degree Centigrade. The pendulum experiments of Bessel and recent determinations by Eötvös seem to establish proportionality between gravitational mass and mass of inertia, irrespective of temperature, well beyond these limits. Thus inertia also would have to increase with temperature; and when a freely moving mass is becoming warmer its velocity must be diminishing, for its momentum must be conserved. A comet like Halley's is heated upon approach to the sun; thus it should suffer retardation in the approaching, and acceleration in the receding part of the orbit, enough probably to upset existing astronomical verifications. Indeed, as regards change of inertia, we can recall the principle applied by Professor Joly to the question whether chemical change involves change of mass, viz., that every mass around us is moving through space with the velocity of the solar system, and a sudden rise of temperature in a body must therefore involve a violent kick if its inertia is thereby sensibly altered.

Electrodynamic theory does establish unequivocally an increase of inertia of a body arising from gain (δE) of thermal or electric energy; but this is only of amount $\delta E/c^2$, where c is the velocity of radiation, and so is minute beyond detection. The question whether there is also an equivalent increase in gravitational mass evades discussion until some link connecting gravitative and electric forces has been established.

U.S.S. "TENNESSEE" TO BE PROPELLED BY ELECTRICITY.

The contract for furnishing the necessary equipment for the electric propulsion of the U.S.S. *Tennessee,* the superdreadnaught of the largest and finest class, now under construction, has been awarded to the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa.

The system of propulsion being installed differs from any now in use by battleships. Instead of the propellers being mechanically connected to the driving engines or turbines, there are two steam turbines developing over 33,000 horse-power driving electric generators which furnish current to four 6,700 horse-power motors, each motor driving a propeller.

Electric drive for battleships has been adopted after a careful investigation by the Navy Department to whom it presented numerous features of structural, operating, and military advantage, among which are: that the steam turbines developing the electric energy may be located in any desired portion of the ship, that the propelling machinery may thus be better protected from injury, that full power may be available for reversing, and that greater rapidity in maneuvering is made possible, compared with existing mechanical systems of control.

In addition to the main generating equipment and propelling motors, the contract includes the auxiliaries for the main turbine generator sets and smaller auxiliary turbine generators supplying light and power throughout the ship. The *Tennessee* will have several hundred electric motors for doing nearly all the work on board from raising the anchor to steering. Electricity will also be used for cooking, ice making, refrigeration and numerous other purposes. In all about 27,500 horse-power of electricity will be needed, the amount required for a city of about 100,000 inhabitants.

OSTEOPATHS FAVOR ELECTRICITY.

One of the most significant features of the twentieth annual convention of the American Osteopathic Association in Kansas City recently, was the large number of exhibits of electrical devices, and the extensive interest of the two thousand members in the application of electricity to the practice. Osteopaths generally are installing high frequency machines, and more and more they are adding X-ray machines, and diagnostic and therapeutic instruments.

UNIQUE UNIVERSAL MOTOR UNIT FOR KITCHENS.

The universal motor unit shown is so constructed that it will drive all kitchen appliances without any reconstruction whatsoever. The driving arm may be raised or lowered to suit any height of appliance. There is a horizontal as well as a vertical drive. The drive shafts are equipped with a chuck and crank. The chuck is used when the handle of the appliance can be easily taken off, while the crank is used when the handle of the appliance cannot be removed. The shelf is for supporting the appliances which have table clamps. There are holding hooks provided to hold appliances in position while being driven. The motor is one-sixth horse-power and is furnished to suit all commercial service specifications as to voltage and frequency.

Here Is an Electric "Maid-of-all-work" for the Kitchen. It Includes an Electric Motor and Various Attachments for Performing Multifarious Operations.

The Unit, as it is called, is finished in dark maroon with the shafts either nickel plated or polished steel.

BATTERY-DRIVEN FIRE APPARATUS.

One of the most interesting applications of the electric truck is to the service of fire departments. Considerable time was devoted to the discussion of this subject at the recent National Electric Light Association convention in Chicago. It was pointed out that equipment of this kind is now in successful use in New York, Philadelphia, Camden, New Jersey; Springfield, Massachusetts; Akron, Ohio, and Hartford, Connecticut, and in Berlin, Hamburg and other European cities.

The experience of the Philadelphia Fire Department is an interesting case in point. Nine pieces of electrically operated fire apparatus are in operation in the city and in two of the fire houses there have been quartered at the same time gasoline, electric and horse-drawn vehicles. On average runs up to a mile and a half the electrics have invariably been the first to the fire, the highest recommendation a piece of fire apparatus could ever have.

HOW WE USE COPPER WIRE.

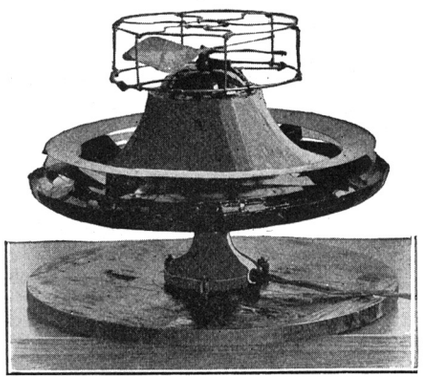
The total quantity of copper wire drawn in 1914, according to the preliminary statement of the Bureau of Census, Washington, D.C., whether for consumption or for sale, was 131,484 tons, as compared with 147,156 tons in 1909, the decrease being 10.6 per cent.

Copper products taken as a group decreased 16.5 per cent in value during the five-year period. In 1909 the weight of all copper wire and wire products, including the copper wire used in the manufacture of insulated wire by the producing companies, but excluding the weight of the insulation, was reported as 154,231 tons. In 1914, when the aggregate weight reported for insulated wire included the weight of the insulation, the aggregate weight of bare wire, insulated wire, and fabricated copper wire products was 135,437 tons, with a value of $42,928,550.

A NOVEL VERTICAL ELECTRIC FAN.

By Frank C. Perkins.

The accompanying drawing and illustration shows the design and construction of



An Innovation in Electric Fan that Moistens Air by Blowing it Over Water Placed in a Trough Beneath the Blade.

a unique, vertical electric ventilating fan, developed at Kansas City, Kansas. It is claimed that this electric device provides a thorough circulation of air in all parts of a room without requiring the fan to be oscillated or revolved in the usual manner and it further provides a novel means for moistening the air in a room. An extremely unique deflector mechanism is adapted to be attached when desired.

In the operation of this device, when the shaft is rotated so as to force the air downwardly, the air so forced will strike the deflector and will be directed thereby outwardly in all directions. Part of this will pass down toward the floor, after passing over the water receptacle. Some of the air will pass horizontally outwardly, being so guided by and between the plate and the water in the receptacle that some of the air will be deflected upwardly by the deflecting plate.

It is pointed out that by means of this construction just described, the air will be kept in constant circulation in all parts of the room. This will be effected without any unequal distribution of the air, such as cause drafts when the circulation is produced by fans which can only force the air in one general direction, or which must be oscillated or revolved in order to force air in different directions.

It is claimed that this vertical electric fan effects better circulation of the air, and without requiring any part of the current which operates it to be wasted for oscillating or revolving functions than can be obtained with the usual stationary oscillating or revolving fans.

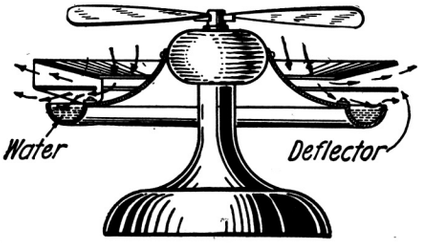


Diagram Showing How New Electric Fan Cools Air.

Electric flashlights of the pocket type are being extensively used by soldiers of all the warring nations. Important signals are often transmitted by flashing the lamp a prearranged number of times.

Bringing Niagara Falls Out of the Night by Incandescent Lights

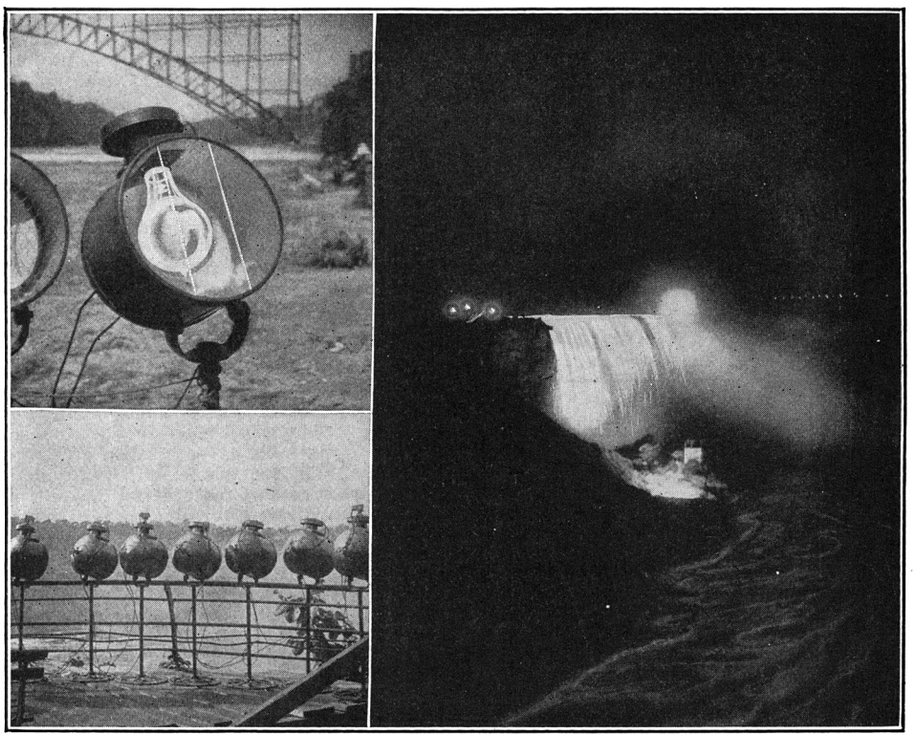
By Raymond Francis Yates

IT has long been considered that the electric arc is the most powerful source of light known, but is far from being the most economical, owing to the terrific heat generated by it. It is acknowledged, however, by all prominent men in the electrical field that incandescent illumination will soon reach that degree of perfection which will make it advisable to entirely abolish the use of the electric arc as a source of light, owing to its undesirable heat and consequent waste of energy.

A distinct and notable advancement in incandescent illumination was recently made when it was decided to light the great waterfall of Niagara by this means. Five years ago, without the aid of the nitrogen-filled lamp, this would have been considered an impossibility, but today, thanks to the efforts of those workers who have labored in this new field, it is not only absolutely practical but far more economical and artistic than any other means.

The lighting of Niagara Falls at night was attempted by a Chicago concern, who manufacture a patented reflector or hood of special design, which, by the corelation of its parts, casts a beam of light that greatly resembles that of sunlight, and instead of being concentrated into a thin ray it spreads out and diffuses throughout the mist of the Falls in a perfectly natural manner. The mist seems to actually scintillate and sparkle under the influence of the light and it is indeed wonderful to think that Niagara is really bathed in the radiance of its own might.

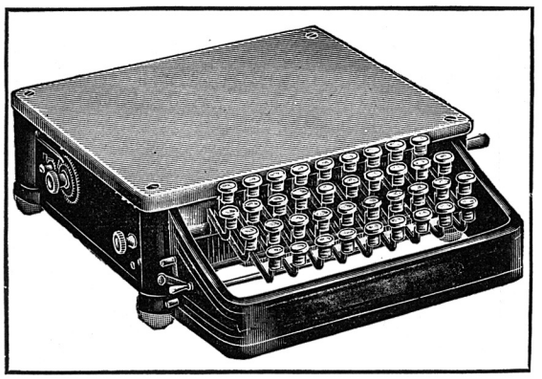
The lamps used in the reflectors are especially designed for this purpose and consume about one kilowatt of electricity, or approximately one and one-third horsepower. It has been decided that one hundred and thirty lights will be necessary to properly illuminate the Falls as well as the rapids. This will consume about one hundred and seventy horsepower. At present twenty-five of these powerful flood lights are focused on the waterfall nightly.



Several Views of Recent Flood-lighting of Niagara Falls. At Left—Group of 1000 Watt, Incandescent Tungsten Lamps Used, also a Single Unit. There Will be 130 Such Lamps Used to Illuminate the Falls.

Automatic Keyboard Transmitter for Wireless and Telegraphy

Of the seventy automatic transmitters patented in the last twenty years, only one has stood the tests under actual operating conditions. There are already a number of automatic transmitters now used in connection with the high speed, mechanical reception, but there is only one, so far, which can be used by any one on any kind of a telegraph line. No matter if an operator has lost the control of his wrist, or if he is absolutely unfamiliar with the telegraph code, he can send out smooth, steady characters which cannot be equalled by manual operation.



An Automatic Telegraph Code Transmitter That Prevents "Telegrapher's Cramp." Works on Any Line. Push the "Letter" Key; the Machine Sends Out the Proper Dots and Dashes.

There are a number of important and unique mechanical features about the present transmitter which have overcome all the difficulties encountered in other types. The first point about the instrument is that no tape is employed, that is, the characters are sent out directly by the pressure of the keys. The keyboard is arranged according to the typewriter standards. When the transmitter is to be used, the spring motor is wound by means of a handle at the right hand side. Then the switch at the left is pressed upward. This releases the keys, opens the line, and starts the motor. To transmit, the keys are pressed with an easy, staccato touch. It is impossible to press two keys at the same time, so that the letters cannot be run together. In sending, the operator quickly learns to work at the speed at which the control is set. A variation of the speed, ranging from ten words to fifty, is obtained by means of the adjusting screw at the left hand side of the case.

While the operator is pressing the keys, a number of ingenious arrangements in the case are performing the usual manual operations. The transmitter is thirteen inches long, eleven wide and four high. The case houses two distinct mechanisms, the motor and the actual transmitting apparatus.

The motor has four separate springs, each containing seven feet of spring, one inch wide. At the left is the speed governor and reducing gears. The mechanism, which makes the dots and dashes, is in a removable unit. Through the center of the unit is a fluted shaft which is turned continually by the motor. Around the shaft are copper character rings, the circumferences of which are broken up by insulated spaces, to form dots and dashes. These rings do not turn ordinarily, however, as the fluted holes through them are larger than the diameter of the shaft. Along the front of the unit is a row of trips, one for each ring. When a key is pressed, a trip is released. This drops the ring so that it engages with the fluted shaft and is revolved. At the back of the unit is a row of contacts for the rings. Ordinarily the contacts rest on insulated parts of the rings, but as a single ring revolves, the circuit is made or broken as the ring turns beneath the contact. On most of the rings are two letters, that is, on the "B" ring, a complete revolution makes —... twice, but rings for the short letters, such as "E" make six dots to a revolution. When a ring revolves far enough to send one letter, a pin on the circumference engages the trip, and restores it to its former position. This also raises the ring from the shaft.

These automatic transmitters are for either Morse or Continental codes. To change from one code to the other, it is only necessary to change the transmitting unit. This requires but a moment's work. For telegraphy, the machine is connected to the line by inserting a spring contact in the key, as other special keys are connected. In wireless work, however, it is necessary to use a pony relay, for the current is too great for the small contacts on the character rings. This transmitter, connected with a buzzer sends out the smoothest signals imaginable.

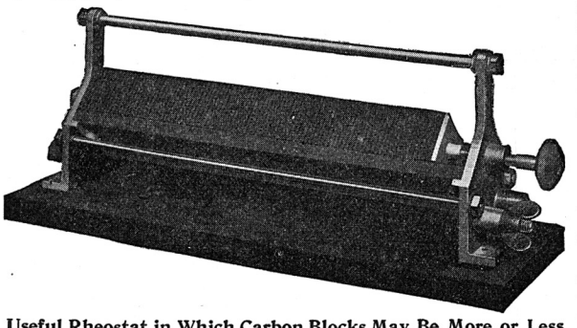
A NEW COMPRESSION CARBON RHEOSTAT.

The illustration herewith shows a new form of compression type carbon rheostat for making fine measurements. A number of carbon blocks are placed in a rack. The distance between the blocks is varied by applying different pressures to them. The pressure adjustment is changed by means of a powerful hand screw compressing the end plate.

This form of rheostat is recommended particularly for use in calibrating electrical instruments, battery testing and photometric work.

The resistance of this device can be varied uniformly by simply changing the amount of pressure exerted on the carbon plates by rotating the tension adjusting screw. The number of blocks in the circuit may be reduced by means of an extra terminal supplied with the rheostat, which may be inserted between any two adjacent plates.

This resistor is made in two sizes of 200 Watts and 1,000 Watts capacity respectively. The smaller unit has a resistance of 10 to 8 Ohms and the larger a resistance of .05 to 2 Ohms. The momentary over-load capacities are 500 and 2,000 Watts respectively.

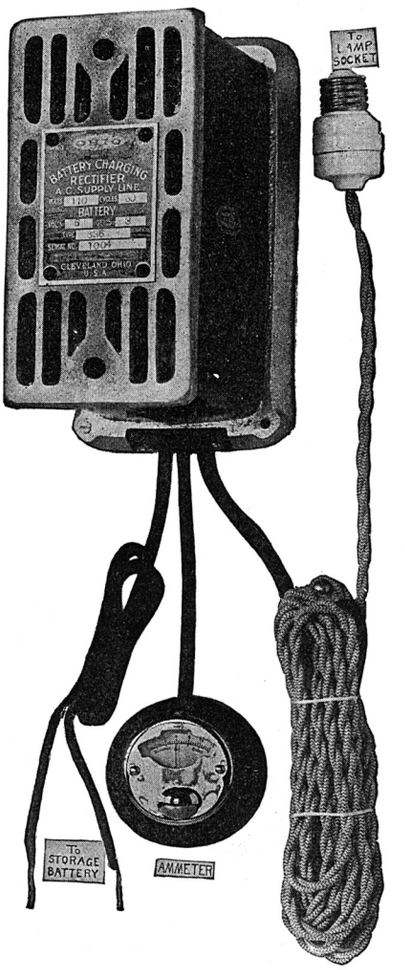


Useful Rheostat in Which Carbon Blocks May Be More or Less Compressed by a Hand Wheel. Excellent for All Laboratory Work.

NEW A.C. TO D.C. STORAGE BATTERY RECTIFIER.

The illustration herewith depicts a new A.C. to D.C. rectifier suitable for charging ignition storage batteries, etc. In operating this device it is merely necessary to screw the plug secured to the end of the lamp cord into any nearby electric light socket and the current is then turned on. The positive and negative wires from the rectifier are then attached to the proper terminal posts on the battery, when the ammeter connected with the outfit will indicate the charging rate. This outfit is particularly efficacious in recharging 6 volt ignition and lighting batteries for automobiles. They can be revitalized over night with this device at a current cost of from 3 to 10 cents, depending upon the capacity and state of charge in the battery.

The equipment here illustrated will undoubtedly find a wide field of usefulness among automobile owners and others having use for such an apparatus. It is provided with non-sticking electrodes and both halves of the A.C. waves are utilized, thus realizing the maximum efficiency for this class of instrument. They are furnished in several sizes, suitable for recharging 6, 12, 16, 18 and 24-volt storage batteries or two, three or four 6-volt storage batteries at one time. They are usually operated on 110 volt 60 cycle A.C. circuits, but can be supplied for other voltages and frequencies when desired.

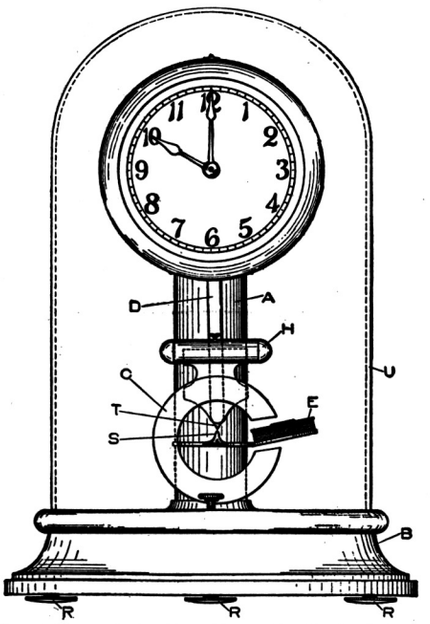


Very Complete Storage Battery Rectifier for Auto Owners and Others. For Use in Changing A. C. Into D. C. Utilizes Both Halves of the A. C. Wave.

The Dutch government proposes to establish wireless communication between Holland and the East Indies by way of San Francisco, Honolulu and New Guinea.

MAGNETIC CLOCK WILL RUN TWO YEARS.

THERE has recently been perfected and placed upon the market a new kind of timekeeper known as the Warren Magnetic Clock, which the manufacturer claims embodies improvements in the mechanism, and especially the escapement, more radical than any made during the previous century.



Front View of the New Magnetic Clock, Said to be One of the Simplest Ever Designed and Extremely Accurate.

From the base of the clock (B) there arises a column (A) which forms a support for the pendulum and the movement, and also contains the battery. The pendulum consists of a permanent magnet (C) riveted firmly to a rod (D) of "Invar," which is a metal practically unaffected by changes in temperature.

Mounted upon the column (A) and located within the gap or opening of the magnet (C) is a coil of extremely fine insulated wire (E), and the ends of this fine copper wire are firmly soldered to two brass rods at the back of the column.

Within the column (A) there is room for a special battery cell of the same diameter but somewhat longer than the cells that are commonly used in flashlights. This battery cell rests upon a strong spring and is held down by the pointed end of a brass rod which may be swung away from the battery in order to replace it.

Mounted upon the pendulum rod is a brass case (H) within which is located an electric pulsator consisting of a sealed glass tube from which air has been carefully exhausted. Inside this glass tube is an inner steel tube, protected from all atmospheric influences such as dust, moisture, or oxidation, containing (presumably) mercury, which sends electric impulses through the coil (E) at every complete swing of the pendulum. These impulses are of such a nature as to maintain the swing of the pendulum in practically the same width of arc whether the battery be new or old. If the swing of the pendulum be increased or decreased by external means, the electric pulsator (H) will quickly restore it to its normal arc.

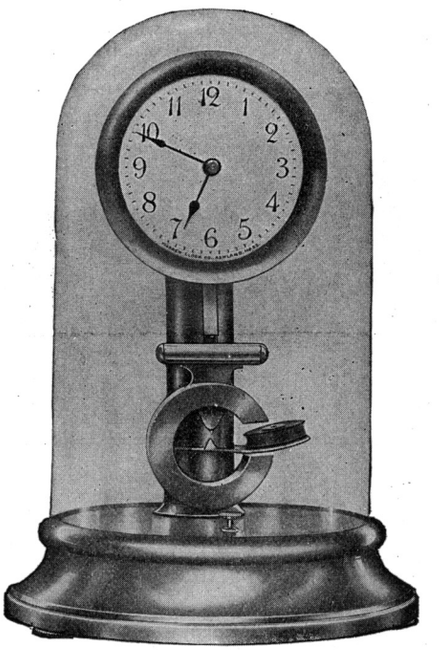
With this clock, owing to the efficiency of the electric system, the battery will last two years in service. The amount of current consumed by the clock is so small that an ordinary dry cell such as is used in ringing bells will easily run twenty-five clocks simultaneously for several months.

Motion is transmitted from the pendulum to the movement as follows: A case which is practically airtight is screwed to the back of a heavy brass plate carrying the movement. Within the case, mounted in sapphire jewels so as to revolve with the utmost freedom, is a vertical pivot made of hardened magnet steel. Upon this pivot is cut a coarse screw thread. Meshing with this screw thread but not clearly shown is a gear mounted upon a horizontal pivot. The lower end of the needle carries a curved extension projecting downward into a cup or depression at the bottom of the case. This cup is nearly filled with a fine quality of light mineral oil. Neither air nor dust can enter the case and the oil which it contains cannot possibly escape. Mounted upon the pendulum rod (D) is a little platform or bracket just below the clock dial, and concealed upon the platform are two very small permanent horseshoe magnets. The poles of the magnets strongly attract the curved extension at the lower end of the needle inside the case, through two thicknesses of metal and an air-space.

According to a new principle broadly patented the reciprocating or swinging motion of the pendulum which moves the pendulum (D) and bracket to and fro across the axis of the magnetic needle causes the latter to revolve once for every complete swing of the pendulum.

The oscillating motion of the pendulum is thus converted into a continuous motion of rotation of this needle and thus by means of a screw thread transmits motion, at a greatly reduced rate, to the first gear of the clock train. The remainder of the clock train is more or less conventional although the bearings are so designed as to run without lubrication. The entire works of the clock are protected by a dust-tight cover.

The advantages of this method of transmission from the pendulum to the clock movement are as follows:



Magnetic Clock Enclosed in Glass Case. It Will Run Continuously Two Years on One Flashlight Battery.

There is no mechanical connection between the pendulum and the movement, and consequently there is no striking or rubbing of any part by the pendulum and no friction; no manipulation is needed to connect the pendulum with the movement. There is nothing to prevent enclosing all the important parts of the clock in an airtight case.

The mechanism for transmitting motion from the pendulum to the movement produces substantially the same drag upon the pendulum whether the clock hands are moving up or down, and consequently the rate of the pendulum and its timekeeping qualities are exceedingly good.

The important parts of the clock movement are enclosed in a tight case partially filled with a fine quality of mineral oil. No dust can possibly enter this case, and the parts cannot become rusty or sticky.

The parts move continuously in oil. No part strikes upon another as in the case of the ordinary escapement, and consequently the movement is absolutely noiseless.

To regulate the rate of the pendulum the following means are employed: A small permanent magnet is mounted beneath the hollow base of the clock so as to be moved against the resistance of a spring by means of an adjustment screw. A perfectly definite force of attraction will be maintained between the end of the regulating magnet and the bottom of the pendulum magnet (C), but the amount of this force of attraction can be varied by the adjustment screw because the force will diminish as the magnet is moved further away from (C) and vice versa.

A very important advantage of this method of regulating is that the clock need not be stopped nor the pendulum disturbed in any way for regulation.

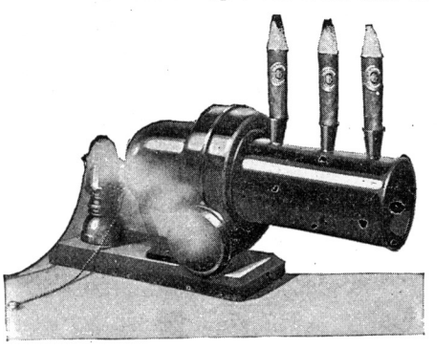
For the purpose of setting up these clocks correctly on a mantel or other surface three leveling screws are provided beneath the base, and a pointer and indicator are on the column and pendulum rod respectively. By these means a person may easily adjust the clock to run on any surface.

WHEN ELECTRICITY "SMOKES" CIGARS.

In tobacco factories and also in many show window displays, it is found desirable to have an electro-mechanical device which will *smoke* cigars in a similar fashion to that followed by mankind in general.

Such an electrical smoker, of neuter gender, is shown in the accompanying illustration. A flexible cord plugged into the nearest electric light socket supplies the miniature motor with power to drive a multiple-vane blower. This blower creates a back draft as becomes evident by the illustration, and thus the *Perfectos* of doubtful vintage, may be smoked rapidly and naturally. The resulting length and character of the ash is noted by tobacco experts.

While a number of more elaborate machines have been brought out from time to time for this particular purpose, the device here described seems to fill the bill at a very reasonable first cost for the apparatus, and also with entire satisfaction in the results obtained.



How Would You Like to Pay the Cigar Bill for This "Electrical Smoker"? It Tests Hundreds of Cigars a Day.

A New Crest Reading Volt-Meter

During the past few years a considerable amount of labor has been spent in developing high voltage measuring apparatus, such for instance as meters which will measure the mean maximum value of a high tension current in which the wave

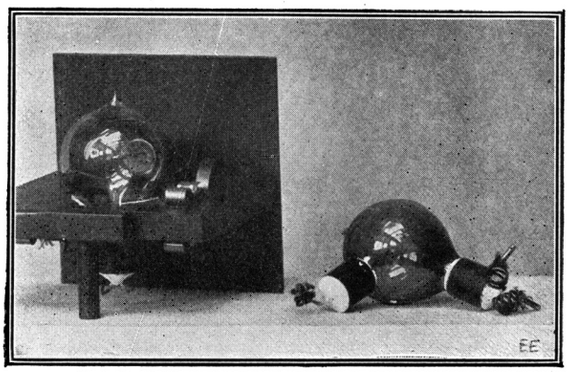


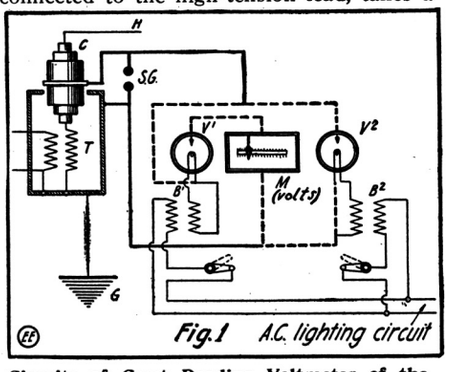
Fig. 2. The Cathode Tube Used in the New Crest Reading Voltmeter Scheme.

produced is not regular. Several ideas were suggested, none of which proved commercially successful. However a special arrangement containing a new form of cathode tube has been used, which shows a remarkable improvement over the other types of meters.

Fig. 1 is a diagram of connections for the crest voltmeter. The testing transformer, T, is in a grounded case; C is a condenser terminal, used to bring out the high tension lead, H. V_1 and V_2 are rectifiers or valves, having anodes of tungsten or molybdenum, and a cathode of incandescent tungsten, working in mercury vapor.

The filament cathodes are heated by the secondary current from the bell ringing transformers, B^1 and B^2, the primaries of which are connected to any suitable A.C. lighting circuit. M is a permanent magnet indicating instrument connected in the anode lead to the valve V^1. A three pole, single throw switch is used to close the cathode heating circuits, or short-circuit the instrument when not in use. SG is a safety gap connected between the leads to the meter to protect the insulation of the apparatus in case of an interruption of the supply to the bell ringing transformers, when the switch is in the working position, or in case of an accidental open circuit in the instrument wiring.

The operation of this device is unusual and interesting. The condenser terminal, connected to the high-tension lead, takes a



Circuits of Crest Reading Voltmeter of the Vacuum Tube Type.

charging current at all times proportional to the rate of change of voltage across its terminals. At both the positive and the negative maxima of the voltage waves this current is zero, and the time integral or area of the current wave between these zero values is a direct measure of the difference between the maximum and the minimum voltages. On account of the unsymmetrical conduction of the cathode valves, the arrangements of circuits shown in Fig. 1 are such that the charging current in one direction passes through the instrument M and the valve V^1, as shown by the heavy dotted line. Current in the opposite direction passes through the valve V_2 without passing through the meter, as shown by the heavy broken line. The thin lines in the figure represent the primary and secondary exciting circuits for the cathode filaments, fed from the lighting circuit. When the meter is not in use the control switch (not shown in Fig. 1) is thrown to the right, which short-circuits the apparatus and opens the primary circuits of the exciting transformers.

The torque of a permanent magnet meter is proportional to the *average value* of the current passing through it, and since for waves of constant length the area is proportional to the average amplitude of the current, it is evident that the meter will give an indication proportional to the time integral of the pulsating current through the valve V^1, and this will in turn be proportional to the crest or peak of the voltage wave.

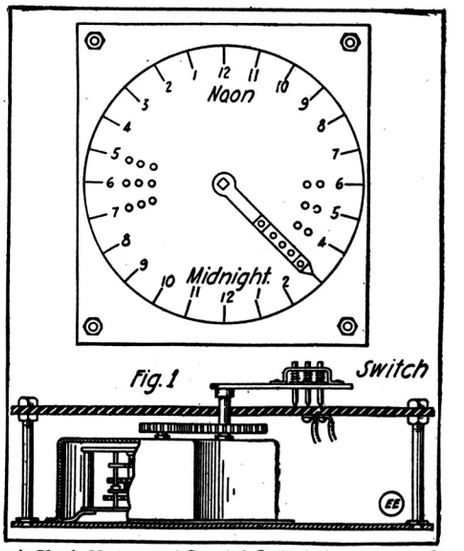
This crest voltmeter is calibrated in parallel with a standard spark gap, or another standardized crest voltmeter and usually the scale is drawn so that it indicates the r.m.s. (root mean square) value of a sine wave having a crest value equal to that of the voltage to which the meter is connected. When thus calibrated it is the equivalent of the needle or sphere gap.

WHAT ONE CENT WILL BUY.

The decreased cost of electric service and the increased efficiency of electrically operated devices are constantly adding to the purchasing power of a cent. On a basis of eight cents per kilowatt-hour one cent will buy: Electric service to light a 25-watt (23 candle power) lamp for five hours; electric service to make ten cups of coffee in an electric coffee-pot; electric service to heat milk in a nursery milk warmer three times; electric service for 300,000 stitches on a motor-driven sewing machine; electric service for twelve cups of tea in an electric samovar; electric service to operate an electric chafing-dish for fifteen minutes; electric service to boil twelve eggs in an electric hot-water cup; electric service for an electric vacuum cleaner for one hour; electric service to warm a heating pad for two hours; electric service for an electric washing machine for one hour; electric service for an electric flatiron for ten minutes; electric service to make ten slices of toast on an electric toaster.

AN AUTOMATIC IGNITER FOR STREET LAMPS.

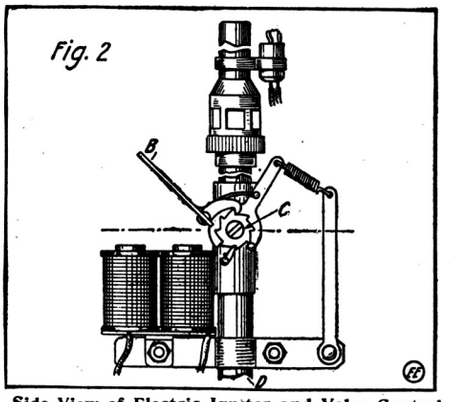
Where gas lamps are utilized for street illumination, there is considerable expense attached to the problem of lighting and extinguishing the gas mantels at night and morning. Besides the employee assigned to this service is not always punctual on his rounds and in consequence some streets are kept in darkness longer than they should be. With these and other objects in mind a New York inventor, Mr. Arthur E. Hynds, has applied for patents on a new automatic electrical igniter and extinguisher. The accompanying illustration will help to bring out the merits of this device which comprises primarily an eight-day clock, for in-



A Clock Motor and Special Switch Attached to It Closes and Opens This Street Gas Lamp Burner Automatically Besides Igniting the Gas.

stance, which controls a specially designed multi-point switch. Owing to the action of the clock the switch functions in the evening and also in the morning. Of course the apparatus may be adjusted for the changing duration of day and night during the seasons.

In the evening the apparatus operates by means of a pair of electro-magnets, Fig. 2, that attracts an iron armature B. In moving toward the magnets the armature, by means of a pawl and ratchet wheel C, opens the gas supply to the mantel at the upper extremity of member D. Just below the mantel is the electric igniter, in the form of a fine wire, which is heated up momentarily and also simultaneously with the opening of the gas valve, as explained. After this action has taken place (in the course of a few seconds), the apparatus resumes ts normal condition and no battery current is utilized during the night. In the morning the clock again causes the switch gear on same to actuate the electro-magnets and this time they close the gas valve, as will be understood from the foregoing and the ignition circuit is not closed. After this operation the electrical circuits are not closed for the rest of the day until evening approaches. This invention seems to be a



Side View of Electric Igniter and Valve Control Magnets on New Automatic Gas Burner.

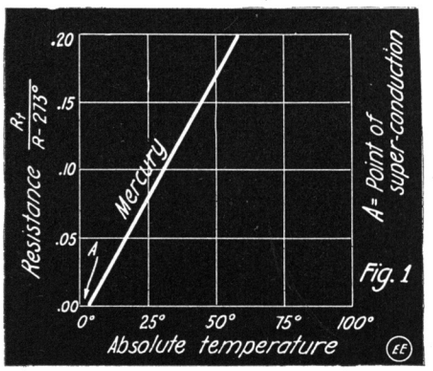
meritorious improvement over existing methods used for the purpose and it seems that it could be adopted by municipalities to good advantage.

The Marvels of Modern Physics

By Rogers D. Rusk, B. Sc.

THE ABSOLUTE ZERO.

THE hardened scientist can juggle queer looking graphs and unbelievably low temperatures in a way to discourage the tyro in the study of heat and low temperatures. However, a brief initiation will introduce him to wonders of amazing interest and of deep meaning. Making snow on the hottest summer day, liquefying a rare gas or producing cold many times as intense as



Graphic Curve Demonstrating Clearly How the Resistance of Mercury Decreases Almost to the Vanishing Point with Falling Temperature.

that endured by the arctic explorers are common-place matters in the laboratory, and the laws and relations discovered through such experiments aid much in clearing up the hidden meaning of things.

One immediately asks if there is any relation between temperature and electricity, for electricity is the one big vital force which interests us all. Yes, a current in a wire will generate heat, and heat, on the other hand, applied to a thermopile will generate electricity, but more than that the resistance and magnetic susceptibility of all substances are so affected as to produce strange phenomena to be noticed at very low temperatures, especially near the *absolute* zero.

The absolute zero, it must be remembered, is the point of lowest possible temperature, far below the zeroes of the Centigrade and Fahrenheit scales. Hot and cold are relative terms. Ice may be warm when compared with frozen mercury at –40 deg. Cent., for in reality hot and cold are only varying degrees of warmth, and a body absolutely cold would be one from which *all* heat was absent. Its temperature would then be at *absolute zero*. Little more than a quarter of a century ago the lowest temperature then reached had been produced by a freezing mixture of salt and water, the minimum for which was –22 deg. Cent. Today we have succeeded in going nearly 250 deg. below that—a big step in twenty-five years, and very close to the absolute zero which has been assumed to be at –273 deg. Cent. Now the location of this point was a puzzling problem. Let us take the definition of heat which says that heat is the energy of molecular motion, then the point "no-heat" or absolute zero would be the point where all molecular motion ceases. To understand this fully it is necessary to know something of the mechanics of gases. Every volume of gas exerts a pressure on the walls of its containing vessel by reason of the kinetic energy of the molecules which keeps them rapidly vibrating, colliding with one another, and bombarding the walls of the containing vessel. If heated, the gas expands, due to an increase of kinetic energy, causing greater vibration, more collisions, and hence higher pressure on the walls of the container. The converse is true if the gas is cooled, and extreme cooling would finally cause all kinetic energy to disappear, all vibration to cease and the pressure to become zero. Hence the volume would also be reduced to a point or zero.

A century ago Gay-Lussac found that all gases have the same temperature coefficient of expansion which is 1/273 of their volume at zero. This amount of contraction per degree would mean that at –273 deg. a gas would contract 273/273 of its volume or vanish. If we consider solids instead of gases, we find that their varying coefficients of expansion cause their zero points to be widely different. Mercury for instance vanishing at –5500 deg. Cent. However, because a gas is the simplest form of matter, and because all gases have the same vanishing point, we assume their zero to be the most reasonable one to take as absolute.

The apparent impossibility of reaching such a point where gases vanish and all molecular motion ceases, indicates that we will probably never attain the absolute zero, although in experimental work we may approach it as a limit.

We may classify the different means of producing low temperature under three general heads:

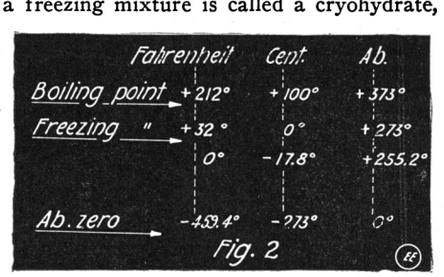
(1) By freezing mixtures.
(2) By evaporation.
(3) By expansion.

Everyone knows that salt thrown upon ice will cause it to melt, due to the chemical attraction of the salt for the particles of water, and even though the temperature

LAST CALL

On November 1st, 1916, the subscription price of "The Electrical Experimenter" advances to $1.50 in U.S. (Canada $1.85, Foreign $2.00.) This is the last chance to subscribe at the old rates ($1.00 in U.S., Canada and Foreign $1.50). No subscription for more than five years at the old rate accepted. THE PUBLISHERS.

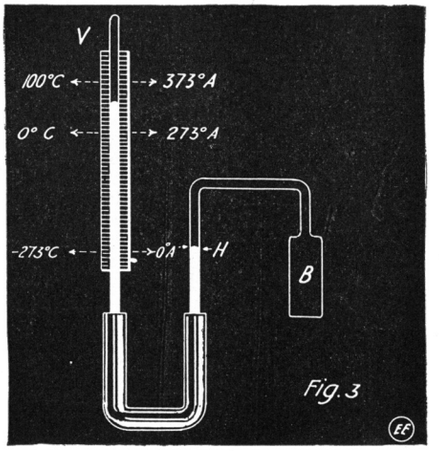
be as low as before the salt water will not refreeze. The reason is that its freezing point has been lowered and it must now be cold enough to both separate the water from the salt, and freeze the water, whereas before it had only the latter to do. Such a freezing mixture is called a cryohydrate,



Comparison of the Fahrenheit, Centigrade and Absolute Temperature Scales. The Absolute Scale Measures All Temperatures in Positive Terms or in Degrees Above Absolute Zero.

and in the case of salt, a proper solution may be reduced to –22 deg. Cent. before freezing; if sodium bromide is used, to –24 deg. Cent., and if calcium chloride is used, to –55 deg. Cent. Such a low temperature is actually produced because the ice absorbs the heat as it melts. The latter is about the lowest possible temperature attainable with a freezing mixture.

A number of gases have been liquefied by compressing them at ordinary temperatures, such as sulphur dioxide, carbon dioxide and



The Gas Thermometer Employed in Measuring Extremely Low Temperatures. Bulb "B" Filled with Hydrogen Gas as Mercury Would Solidify.

ammonia. When condensed they must be kept at a constant temperature. Many other gases, known as the permanent gases, cannot be liquefied by pressure alone because they must be cooled below a certain point for each gas, known as the critical temperature. If the gas is not cooled to this point no amount of pressure will liquefy it. Methane gas must be cooled below –82 deg. Cent., Nitrogen below –146 deg. Cent., Hydrogen below –241 deg. Cent., and Helium below –268 deg. Cent. To liquefy the latter is a task indeed.

A drop of ether or chloroform on the hand feels cold, due to the heat absorbed from the hand when it evaporates, and this suggests to us one of the best methods of obtaining low temperature—by evaporation. For instance, carbon dioxide may be liquefied at ordinary temperatures, but when evaporated it produces the low temperature of –78 deg. Cent.

Our foremost investigator of low temperatures today is Kamerlingh Onnes, of Leyden, Holland, who has produced lower temperatures than any other scientist. Onnes evaporates one gas to cool another below its critical point, and the latter on evaporating produces a still lower temperature. This process might be carried on *ad infinitum*, if it were not for various limiting reasons. In one instance he evaporated methyl chloride in order to cool and condense ethylene, which was then itself evaporated to cool and liquefy oxygen. When the oxygen was evaporated under reduced pressure it gave a quite constant temperature of –217 deg. Cent. By a more complex process, helium was liquefied, and upon evaporating it under reduced pressure, Onnes obtained the marvelously low temperature of –271.6 deg. Cent., or within less than two degrees of the absolute zero.

A third method of cooling can only be mentioned which depends upon the principle that gases upon expanding absorb heat. By this method alone fairly low temperature may be produced, and it was this principle combined with the method by evaporation, which enabled Onnes to liquefy Helium.

(*Continued on page 456*)

The RADIO LEAGUE of AMERICA
HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.
H. Cernsback, Manager

President Wilson Opens Centennial by Radio

By W. H. Kirwan (9XE)

FOR the first time in the history of the United States, the President opened a celebration by wireless on Monday, June nineteenth, the message having been received by an amateur station. For the first time in the history of the country, real Americans (Indians) received a wireless message direct from the "Great White Father."

The Centennial at Fort Armstrong, Iowa, was an event of great moment for the people of the Middle West. One hundred years ago the old block-house, called Fort Armstrong, was built on Rock Island Arsenal. To-day an exact duplicate of it has been erected in the same location. To commemorate this historical event and rebuilding of the new block-house, the people of the Middle West arranged one of the greatest historical and home-coming events ever witnessed.

One hundred years ago old Black Hawk, the chief of the Sacs and Fox tribes, held sway in this territory and ruled as a king. To-day his descendants joined with the white folks in celebrating the Fort Armstrong Centennial. Several of his direct descendants were present, among them being his grandson, Logan Ka Ka-Que, and his great-grandson, Jes Ka-Ka-Que, together with numerous squaws and papooses, descendants of the remnants of the once powerful tribe.

The author was commissioned to open the Centennial by wireless, and arranged with Mr. Tumulty to have the President press the button to Arlington, NAA, and open the Centennial officially at 12 o'clock noon, Central time. The President had agreed to this arrangement and at 1 p.m., Eastern time, June 19, 1916, Arlington sent the long dash, officially opening the Centennial. This was followed by a characteristic message from our President, which is quoted below:

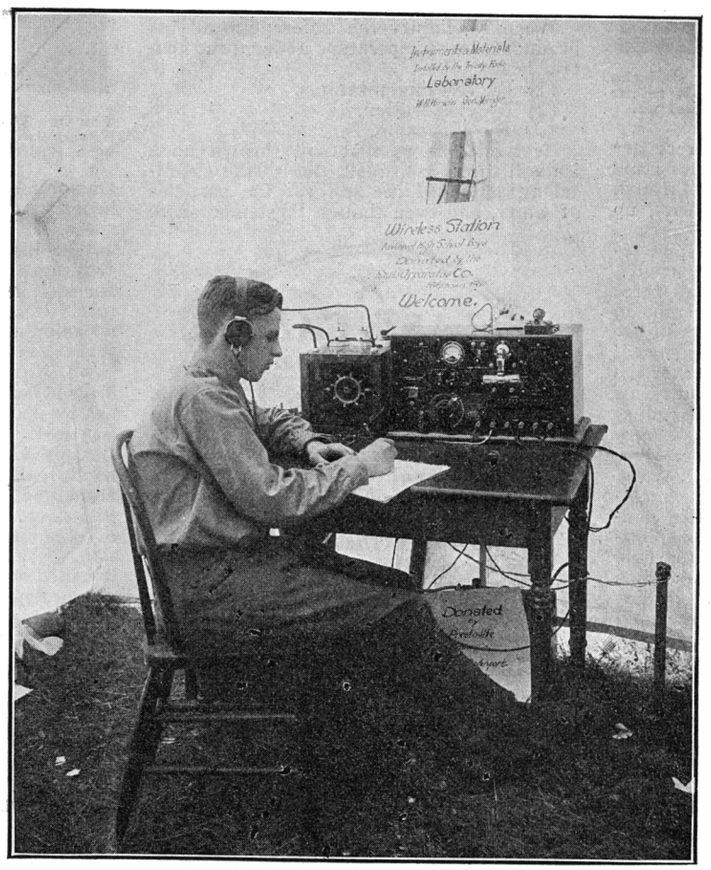
"To the People of the Middle West: I fear that it is only too certain that I shall be bound fast here and that it will be impossible for me to be present, but I shall, of course, take real pleasure in complying with the request to press the button which will signal the opening of the celebration. I am complimented that you should desire me to do so.

"WOODROW WILSON."

The great-grandson of Old Chief Black Hawk was *listening in* at the signals and, for the first time in history, one of the real Americans received a wireless message from the President. At the moment the dash was received from Arlington a signal was given to the grandstand and numerous balloons were liberated and also a large number of white doves, being the Symbol of Peace, and the American flag was hoisted to the top of the mast, while the band played "The Star-Spangled Banner." It may interest readers to know that the great-grandson of Black Hawk is quite an intelligent man and knows considerable about wireless telegraphy.

The author made arrangements with several wireless companies who kindly loaned the necessary instruments and a large tent was erected on the Rock Island Arsenal, as the official wireless headquarters. The local members of the Davenport Radio Club were given full charge of the station and, with the assistance of the Boy Scouts, soon had the aerial erected, a single wire 500' long, 60' high. A ½ K.W. sending set was installed in the tent, and messages were sent and received from the surrounding cities. Several of the boys were on duty at all times and slept in the tent.

Of the many thousand visitors to the Rock Island Arsenal during this memorable week, it is safe to say that very few of them left the Arsenal without viewing the wireless outfit and asking innumerable questions. A few copies of THE ELECTRICAL EXPERIMENTER, which were on exhibition at the wireless tent, were worn to a frazzle. Some of the visitors had never seen a wireless outfit at all, as they had been living far removed from railroads and civilization for a great many years. Many of them were permitted to hear Arlington send their routine report and time during the week and all expressed astonishment at the clearness of the signals. An Oscillaudion bulb was used and was lit continuously the whole week, but did not seem to affect the storage battery which was used for the purpose of lighting the bulb alone.



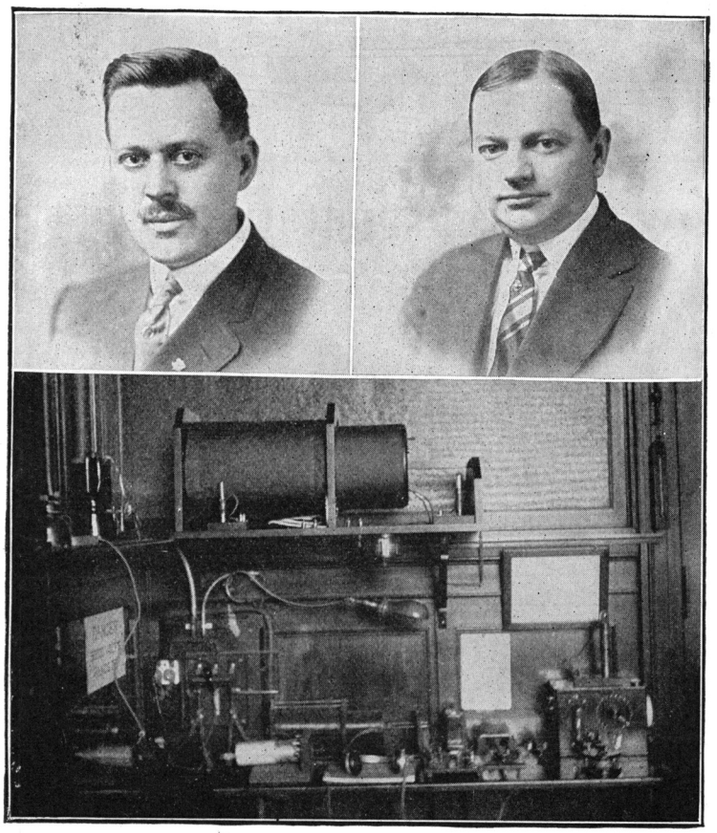
Radio Receiving Set Installed for the Centennial at Fort Armstrong, Iowa, and Over Which American Indians for the First Time Heard a Wireless Message From President Wilson.

Each year the amateurs of the United States are doing something unheard of and the author was greatly pleased to have started off the present year with a National Radio Relay that reached from coast to coast. With this event, which is really history, the amateurs have again demonstrated their ability to do things by opening one of the largest Centennials in the Middle West by Wireless, direct from the White House, and without any help from the commercial stations.

The Wireless Outfit was as much of a curiosity and point of interest to the Army officers at the Rock Island Arsenal as to the visitors because, as will be remembered, the relay of February twenty-second, which was sent in the interest of Preparedness, was started from Rock Island Arsenal at the suggestion of Colonel Nicholson, whose name, however, was badly twisted by a great many of you before it reached both coasts. Rock Island Arsenal does not have a wireless installation and we think this is peculiar, but it is surrounded by a number of adjacent amateur stations, which can receive messages direct from Arlington, NAA, Lake Bluff, Ill., NAJ, and various other Government stations. The amateur stations are also situated around the Arsenal in such a way that a man with the semaphore signals could easily send any messages direct to the Arsenal from any of these amateur stations.

For the benefit of those who assisted the author in his several relays, it may be of interest to know that another relay of *International* importance is being arranged for September, as well as a very complete and efficient testing arrangement, so as to get the real ranges for sending and receiving of the various stations, some of which are boasting of unheard of distances. This event will be of great importance to all the amateurs in the country, and the author's advice to you is to read THE ELECTRICAL EXPERIMENTER regularly, so that you

will get all the instructions necessary. Tell all of your local radio amateur friends about it.



Mr. Muhlheizler (left) and Mr. Weaver (right) Who Explained Their Undamped Wave Audion Receiving Outfit to Members of the "Western Pennsylvania Radio Society" at a Recent Meeting of the Society.

The Amateur Marconi Radio Association of Troy, N.Y.

THE photo here shown is one taken while several of the members of this club were out testing the portable sets shown to the right.

At the last meeting of the A.M.R.A. the club was addressed by Roland B. Bourne, a former commercial wireless man, who spoke interestingly on the "Alternator frequency-changer method of transmission," as employed at Tuckerton. Delegations from the Albany and Schenectady radio associations were present and it is planned to conduct tri-city radio conferences. It was decided to postpone the erection of a semi-powerful station on the Troy Y.M.C.A. building until fall. As can be seen in the photo, two portable sets are available and extensive tests are being carried out during the summer. E. Malcolm Williams gave a brief talk on the "Elementary Mathematics of Aerial Construction." The semi-annual election of officers was also held at this meeting. William A. Le May was chosen as president to succeed Wendell W. King, who enters Union College this fall for a course in electrical engineering. John T. Zimmer succeeds Mr. Le May as vice-president, and E. Malcolm Williams succeeds Harold G. Connor and Charles E. Everingham as secretary and treasurer respectively. John D. Adams and Mr. Zimmer were elected station inspectors. During the summer months but one meeting a month has been held. This association solicits correspondence from western radio clubs. Communications should be addressed to the secretary at No. 1627 Seventh Avenue, Troy, N.Y.

The club has a number of new ideas.

DO YOU

own a wireless station, either for sending or receiving? If you do, don't fail to join the greatest Wireless Association in the country: THE RADIO LEAGUE OF AMERICA. If you believe in the preparedness of your country, if you wish to help Uncle Sam, if you wish to have your station **officially** recognized, join the LEAGUE, a national, non-money-making organization. Beautiful engraved and sealed certificate, FREE to all members. NO DUES OR FEES WHATSOEVER.

Honorary Members: W. H. G. BULLARD, U. S. N.; PROF. REGINALD A. FESSENDEN; DR. LEE DE FOREST; DR. NICOLA TESLA.

Send stamp for large 8-page information booklet. **DO IT NOW.**

233 FULTON STREET, NEW YORK

Wireless Activities in Western Pennsylvania.

THE Western Pennsylvania Radio Society held a general wireless meeting a short time ago in the Miller Building, Fernando Street, Pittsburgh. An undamped wave receiving set has been installed here by Messrs. Mühlheizler and Weaver, of the Pittsburgh and Allegheny Telephone Company, who were in a great measure responsible for the establishment of the society a little over two years ago. The society is composed of about eighty amateur operators of this section of the state and has been instrumental in developing a great amount of interest in wireless telegraphy and in providing a clearing house for the ideas of its members. The society meets quarterly. At this last meeting the operation of the undamped system was explained by the two P. & A. Co. engineers and was of particular interest to the amateurs.

The accompanying photograph shows the large loose coupler wound with No. 28 s.s.c. magnet wire on tubes 8″ and 10″ in diameter and 15″ long, thus getting a sufficient wave length so that primary and secondary *loading inductances* (as are required in the Armstrong circuits) are dispensed with. The large loose coupler is the main feature in this set.

An oscillating vacuum detector is wired in the small box shown to the right. An operator's telephone key is used to cut in either the large or small loose coupler. Another similar key changes from mineral to audion. The question is often asked—"Will an undamped wave receiving circuit receive damped waves?" We find that it will, but not as efficiently as with the ordinary damped wave hook-up.

Before building the large loose coupler we used the damped wave circuit, Fig. 1, on the small loose coupler. When the large loose coupler was installed we changed the vacuum detector box wiring to Fig. 2 (undamped), which works well on undamped but not so well on damped waves. We intend to get another bulb and wire it for Fig. 1 (damped) or arrange several telephone keys to change the audion circuit from damped to undamped, unless we can discover a combination that works equally well on damped and undamped waves.

It might be mentioned that the primary of the large loose coupler contains 900 turns of wire. The first switch tap takes 400 turns and each succeeding tap 50 turns. The secondary has 1,100 turns and is tapped out every 100 turns. When one begins to get undamped waves the first thing that strikes one is that there is as much difference between damped and undamped waves as there is between day and night. We hear practically all the large undamped waves commercial stations and would recommend a large loose coupler in preference to a

(*Continued on page 456*)

RADIO AND WIRE TELEGRAPHERS IN DEMAND.

The greater use to which wireless telegraphy is being put daily, has caused an ever-increasing demand for operators of the instruments. This is a field that is not overcrowded and little likelihood of becoming so for a long time. Old hands at the Morse system are going to the Marconi system, and yet the demand for both male and female operators continues to increase. Telegraphy is a business easily learned and salaries for it are good, ranging from $14 to $30 per week.

AMATEUR WIRELESS IN HOLLAND.

It is reported that a movement is on foot to start a wireless society for Dutch amateurs. There are many keen wireless amateur enthusiasts in Holland, and accordingly there should be no difficulty in forming a wireless organization comparable to many in the United States.

The Members of the "Amateur Marconi Radio Association" of Troy, N.Y., Recently Conducted a Successful Field Test on Their New Portable Radio Outfits.

Some Interesting New Radio Apparatus

IN the two previous issues of *The Electrical Experimenter*, several commercial type instruments have been described in detail and in this issue we take pleasure in showing several miscellaneous instruments of the latest design for use in radio work.

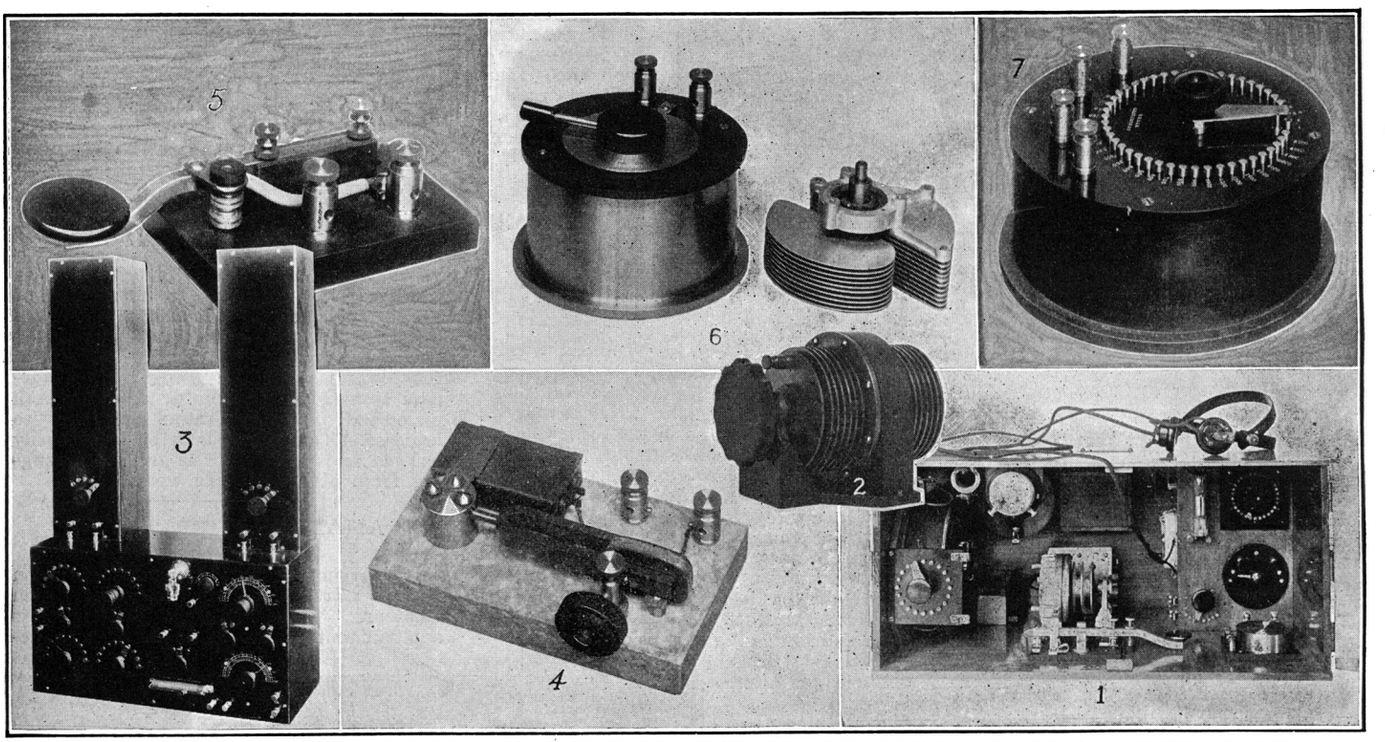
A 1/6 K.W. aeroplane outfit is shown in Fig. 1. This set is equipped with a Chaffee gap, shown behind the key. The distance between the electrodes is controlled by an insulated knob. The oscillatory circuit is composed of an oscillation transformer, at the left, the inductance of which is regulated by multiple-point switches on both primary and secondary. The capacity

ratus. The generator which supplies current to the arc is placed in front of the machine and is fitted with a propeller so that the powerful air currents produced when the machine is in motion, rotate the dynamo. Tests have proven that the outfit is thoroughly satisfactory for the purpose outlined.

A photograph of the Chaffee gap is illustrated in Fig. 2. The sparking terminals are enclosed in a gas-tight chamber and each copper electrode is fitted with a number of radiating fins to keep the electrodes cool when they are in operation. The spark is produced in an atmosphere of hydrogen gas, the connections being made

inductively coupled tuner, the switches of which are located on the left. Two variable condensers are placed on the right, a vacuum detector being used. It can be connected in such a manner as to cause it to oscillate for undamped wave reception. This is a good model for the amateur to duplicate as it is particularly well designed.

A buzzer which produces a tone of definite frequency has been in demand for many years. Such a buzzer is illustrated in Fig. 4. This instrument develops a frequency of 500 cycles, which is the exact tone of most radio transmitters used both on land and on shipboard. The apparatus consists of an oblong electro-magnet placed



Radio Apparatus Shown Above—1. Compact Aeroplane Set. 2. Chaffee Gap. 3. Receiving Cabinet for Damped and Undamped Waves. 4. 500 Cycle Hytone Buzzer. 5. Transmitting Key. 6. Variable Condenser Giving a Straight Line Calibration Curve. 7. Audibility Meter for Measuring Intensity of Received Signals.

comprises a mica condenser secured to the base to the right of the oscillation transformer. The two coils seen on top are impedances for controlling the current in the gap. The receiving outfit consists of a special inductively coupled tuner, variable condenser, loading coil and a vacuum detector, as shown at the right. The instrument in front of the receiver is a high frequency buzzer, used for testing.

The complete unit is placed in a substantially built case to make it compact. The outfit is said to weigh only thirty pounds, which is remarkably light as compared with most other types of aeroplane radio appa-

from the ends of the vanes, while the sparking distance is regulated by the large knob. This gap operates on 500 volts direct current and is rated at ¼ K.W.

A very efficient and well designed radio receiving set is shown in Fig. 3. It is capable of receiving stations having a wave length of from 200 to 20,000 meters and the circuit is so arranged that it is possible to hear both damped and undamped transmitters. This is done by the Armstrong regenerating circuit, which has been described in previous issues of this journal. The aerial loading coils are on top of the cabinet. The set itself is made with an

between the prongs of a tuning fork emitting a 500 period note. This represents the vibrating membrane of the device, and it is supported on a standard by a single rod from the tuning fork, thus giving the ends a free motion. A platinum contact is secured to one end of prong while the other is fastened to an adjustable screw. A rubber knob is placed on this screw for regulating purposes. This is seen supported on a binding post in the foreground. The electro-magnet and the adjustable electrode are connected in series while the other terminals are made with the two binding posts

(*Continued on page 458*)

AMONG the hundreds of new devices and appliances published monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnished to you, free of charge, by addressing our Technical Information Bureau.

NEW SYSTEM OF RADIO TELEPHONY.

The radio engineer of today is still laboring on the important problem of transmitting speech without wires, and recently various systems have been developed, one of which was brought out through the research of Edward G. Gage, a well known radio investigator of New York City. His system has been thoroughly tested by the D.L.&W.R.R. at their Hoboken station, and the results obtained are more satisfactory than from other apparatus previously tested.

The high frequency alternator employed for producing the sustained waves is a modification of the Fessenden type. A remarkable feature of this mahcine is the fact that it runs at a tremendous speed of 40,000 R.P.M., just double the speed of the Fessenden or Alexanderson machines. The alternator used at Hoboken is driven by a 3-horsepower motor run by 150 storage batteries. This is done to secure constant speed regulation.

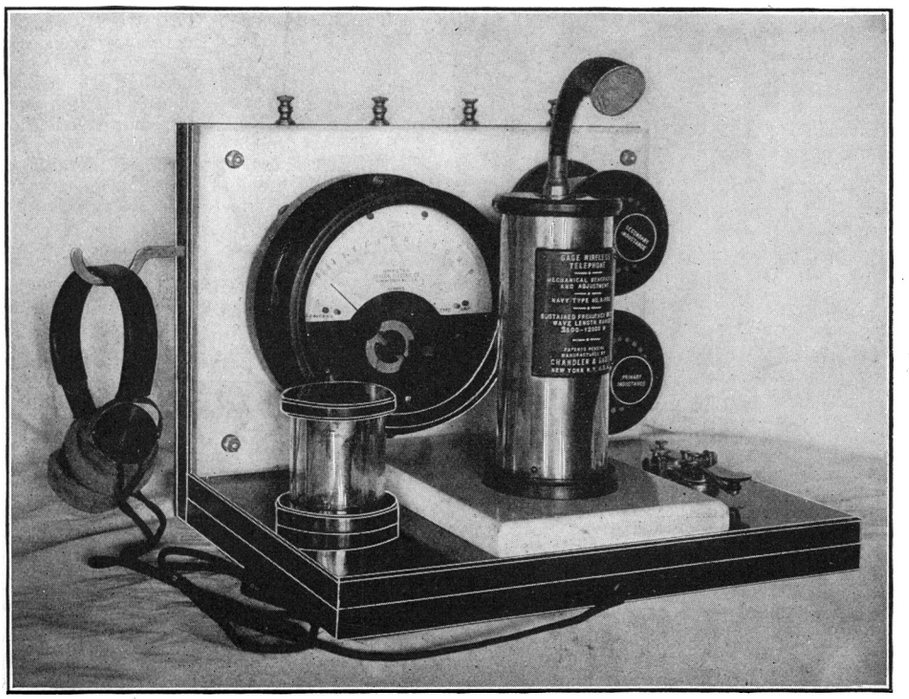
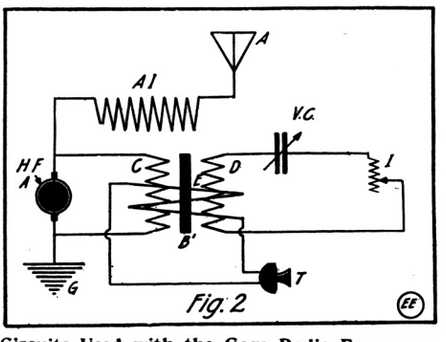


Fig. 1. Control Panel, Switch Hook, Microphone, Detector, Etc., Used in the Gage Radiophone System.

The control panel is illustrated in Fig. 1. At the right of the panel are two circular cases. In these the inductances are placed, controlled by a circular switch. The upper one is used as a secondary inductance, while the lower one is the primary. The amount of current which is radiated by the antenna is read on an ammeter, beside the inductance. The modulated current is controlled by a specially designed microphone placed in front of the panel. This microphone is provided with a water cooling system, so that if a large amount of current is to be controlled,



Circuits Used with the Gage Radio Frequency Alternator System of Radiophony.

water is sent through it to cool the microphone elements and their chamber. A special form of mouthpiece is employed to collect all the vibrations of the voice. At the left of the microphone can be seen the Fessenden electrolytic detector for receiving. A key, which is used for calling is mounted at the right of the microphone.

The novel transmitting circuit which is actually used in this new system is shown in Fig. 2. The high frequency alternator is connected directly in the antenna and ground circuit as indicated, and is shunted across a receiving coil C of a three coil transformer B. The second coil D, of this transformer is connected in series with a variable condenser VC, and an adjustable inductance I. The third coil E is linked to a telephone transmitter. This coil is wound over both of the other two coils CD. The principle involved is the modification of the antenna current by detuning.

In operation, when the telephone receivers are removed from the hook, the generator is automatically started, and thereafter no adjustments are necessary as long as the generator is run at a constant speed. A small button operates the change-over switch. From two or three amperes are usually radiated from the antenna.

The complete system has been employed in a series of tests by Mr. Gage, at a testing station on Long Island Sound. The National Electric Signaling Company cooperating in this work, with their apparatus on Fall River line steamers.

The use of the high frequency alternator makes it particualrly applicable to railroad work, since it requires practically no adjustments. One objection is, of course, the expense of an outfit, but it is believed this can be reduced sufficiently to make it practical.

RADIO TELEPHONY ON THE MEXICAN FRONT.

Although many people imagine that the Mexican government has been asleep in regard to radio communication affairs, yet that idea is somewhat incorrect, as that government has today fourteen excellently equipped radio land stations and several portable radio telegraph and telephone outfits which are expected to be used on the border if any hostilities occur between the Mexicanos and ourselves. The illustration shows one of five Mexican portable radio outfits, which can either be used as telegraph or telephone transmitters.

The transmitter consists of an arc generator of the quenched type, placed on the side of the cabinet as shown in the upper left corner. The fan below the gap is used for cooling it when in operation. The variable condenser and aerial inductance are mounted on the same panel as the arc. The current for the arc is obtained from a high voltage, direct current generator, not shown in the photograph. Either the telegraph key or telephone transmitter can be put in circuit by changing the double-pole switch located on top of the case. The key is shown next to the change-over switch, while the microphone is supported on a frame on the front panel. This is of a special design consisting of two microphones connected together by a single horn. In this way a larger amount of current can be controlled.

The receiving instruments shown standing to the right of the transmitter are of the Audion type, which comprises a standard inductive coupler, the inductances of which are controlled by switches. The primary of the tuner is connected with a loading coil to permit reception of high wave lengths. This is also regulated by means of a switch. Two variable condensers are enclosed in the same case, the variations of which are obtained by turning either of two knobs mounted on the panel. The detector em-

(*Continued on page 459*)

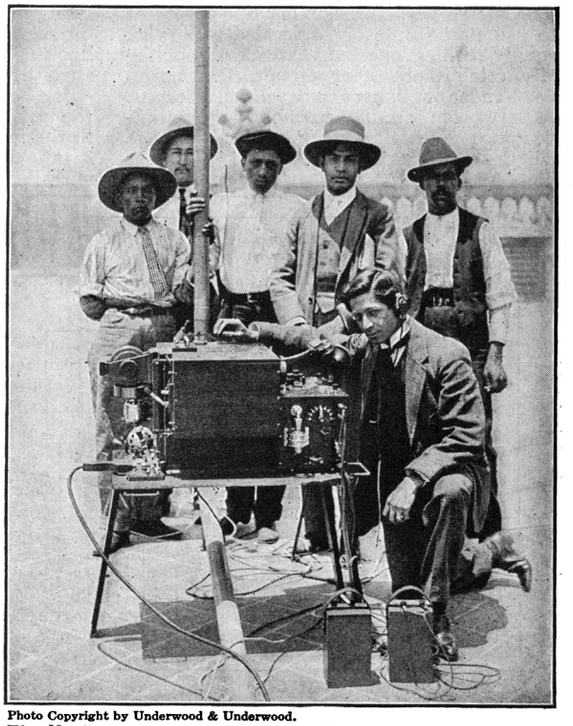


Photo Copyright by Underwood & Underwood.

The Mexicans, Contrary to Public Opinion, Have a Number of These Radiophone Outfits of the Latest Type.

NOVEL RADIO APPARATUS.

A number of efficient radio transmitting and receiving apparatus have recently been developed by Mr. E. C. Mignon, the well-known radio engineer. Herewith is illustrated a new vacuum detector cabinet, receiving set consisting of a special loose coupler with units and tens adjustments in the primary and a ten-section variable secondary, a large ten-section loading inductance, and a duplex rheostat for the minute regulation of filament battery by two separate terminal switches of special resistances. The filament current is cut off by turning upper rheostat switch lever to extreme left and off the contact points; this prevents the lighting of the Electron Relay filament without the use of the protecting resistance. Further, there is a small fixed condenser of special design, 2 F. M. condenser, and a 43 plate rotary variable condenser and a Master switch. This cabinet set is equipped with a Rotary Inter-Change switch, enabling the operator to use either Bulb or Mineral detectors by simply turning one knob, which automatically establishes either circuit, leaving no dead-ends or unnecessary closed circuits. A large ten section variable loading inductance gives this set a very high wave length capacity. The 12 3-cell flashlight high tension battery is controlled by a 9-terminal silent switch, the lever traveling on a perfectly smooth surface, without the use of dead contact points. A six volt storage battery or three to four ordinary dry cells connected in series, are required to operate this set. A special complex bulb circuit is employed in this set as will be noticed in the accompanying photograph, by the auto-transformer encircling the vacuum bulb.

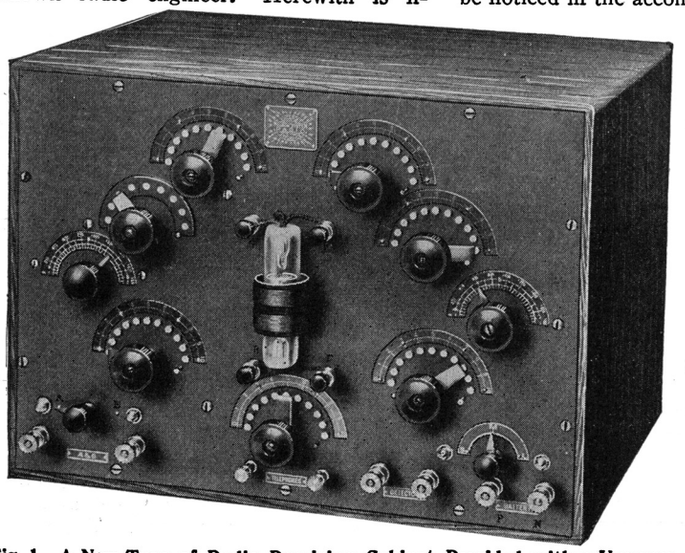


Fig. 1. A New Type of Radio Receiving Cabinet Provided with a Vacuum Tube Detector and Auto-Transformer Wound About the Tube as Seen.

The auto-transformer consists of a fiber tube 1⅜ inches in diameter and 1⅜ inches in length; the windings are of No. 22 B. & S. double silk covered magnet wire with 14 turns to each coil. This transformer is of distinct importance when using the apparatus for receiving undamped waves since its magnetic field oscillations are in absolute synchronism, consequently stimulating the periodical electron discharge from the filament and the ionization of gas within the bulb by the heat of the filament the manufacturers claim.

The interchange switch (at lower left of cabinet) consists of a hard rubber rotating rod carrying two sets of strips for the connecting of spring finger contacts; the first five make connections for bulb detector and the second two for mineral detector circuits. Fig. 2 shows the hook-up of the various parts of the receiving set.

It should be noted that the small fixed condenser in the grid circuit and the 2 mf. condenser in shunt with the high tension batteries are of a new type, which has proven far superior to the usual plate affair. The form of cable used in all of these sets is made up of two D.S.C. magnet wires, wound on together at the same time; these two wires, coiled, were found to be more efficient than any other winding tried out by Mr. Mignon.

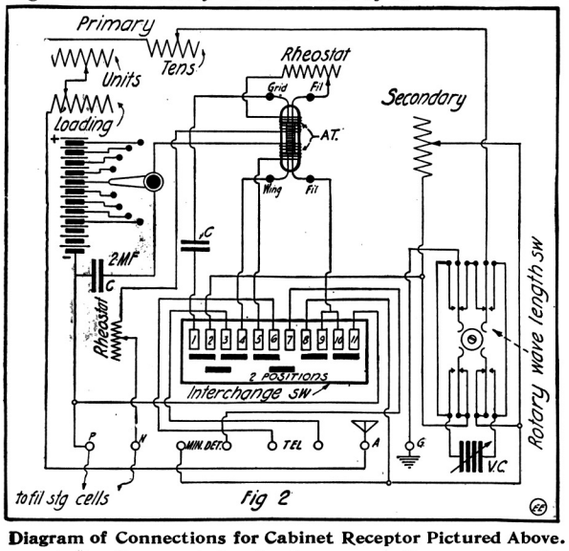


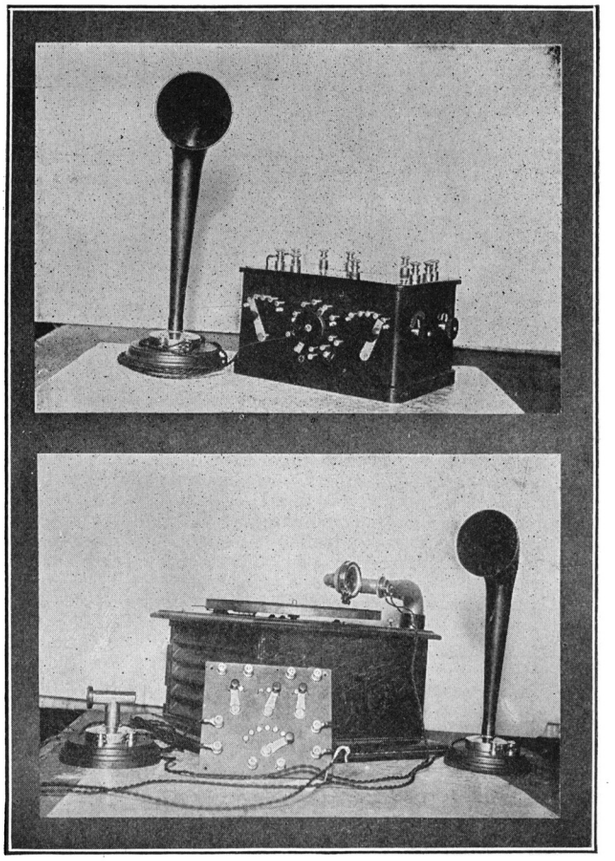
Diagram of Connections for Cabinet Receptor Pictured Above.

AN IMPROVED AMPLIFIER FOR RADIO AND PHONOGRAPHS.

The long standing need of a suitable amplifier for the radio experimenter has recently been filled by Leon Bishop, the well-known inventor, who has devised a successful, double-step, microphonic amplifier for use in boosting the incoming signals.

The instrument is herewith shown and consists of two sets of microphones actuated by a solenoid electro magnet. A description of the constructional details of the sensitive element was given at length in the October 1915 issue of *The Electrical Experimenter*. The control for both microphones are located on the side of the instrument case as indicated at the right. The two outside switches vary the current in the low resistance circuit, while the center one controls both amplifiers so that they may be both in tune with each other. Two small induction coils are interposed in each amplifier circuit so as to obtain the maximum effect with a minimum current.

A considerable amplification is obtained with this instrument and with the use of a loud speaking telephone, messages can be heard quite a distance from it. The sound magnifier seen standing to the left is used in conjunction with the amplifier and it is used as a desk instrument. This is nothing more nor less than a low resistance telephone receiver fitted with a horn. Amateurs who are interested in radio amplifiers will certainly find this one very satisfactory.



Above:—New Two-step Amplifier Adapted to Radio Receiving Work and Telephony. Below:—Special Form of Amplifier for Use on Phonograph so that Music May Be Heard Anywhere About the House or Garden.

A sweet strain of music emanating from a bush in the garden—the sound of a brass band coming from all sides of a room—such was the problem before many musical investigators who have sought for years to devise some means whereby music can be, for instance, transmitted to the different parts of a building with the aid of a single transmitter. This problem was at last solved in a simple manner by Mr. Bishop, who employs a single phonographic machine fitted with a microphonic amplifier connected to several loud speaking telephones which are stationed in different locations.

A single phonographic equipment is shown here. The microphone is of minia-

(*Continued on page 460*)

WIRELESS NEWS PICKED UP 7,000 MILES AWAY.

The wireless station at Sabang, Dutch East Indies, has recently been able to hear German war news being telegraphed by radio from Nauen, near Hanover, Germany, and British messages sent from Carnavon, Wales, a distance of approximately 7,000 miles.

The successful transmission is taken as indicating the desirability of the establishment of wireless communication between Holland and her Far Eastern colonies.

CARRIER PIGEONS AND RADIO WAVES.

French scientists are inclined to think that carrier pigeons are influenced by magnetism and that, with the growth of *wireless telegraphy,* much less dependence can be placed on them.

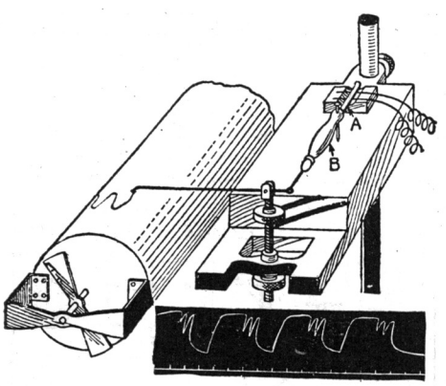
FROG'S LEG MAKES IDEAL RADIO DETECTOR.

Some time ago, attempts were made to utilize the leg of a frog as a radio-telegraphic detector. The illustration shows how it can be arranged to trace an undulatory curve on a revolving cylinder. The final graphic representations of the Morse signals are also shown in the illustration.

In utilizing the frog's muscle for recording wireless messages, the sciatic nerve of the leg is connected with the microphonic circuit of the receiver. One end of the leg is fixed to a base and the opposite end connected with a pivoted lever, as indicated in the illustration, so as to record on a slowly revolving, paper-covered drum the contraction of the muscles caused by the electric impulses.

As pointed out in a very interesting new work entitled, "New Concepts in Diagnosis and Treatment," by Dr. Albert Abrams, this arrangement is many times more sensitive than popularly supposed. Dr. Abrams in his interesting researches concerning the effects of extremely slight and almost immeasurable electric currents upon the human system, and particularly upon the human stomach, has found that for one thing, the ordinary stomach is many times more sensitive to slight electric charges or currents than any galvanometer or like device.

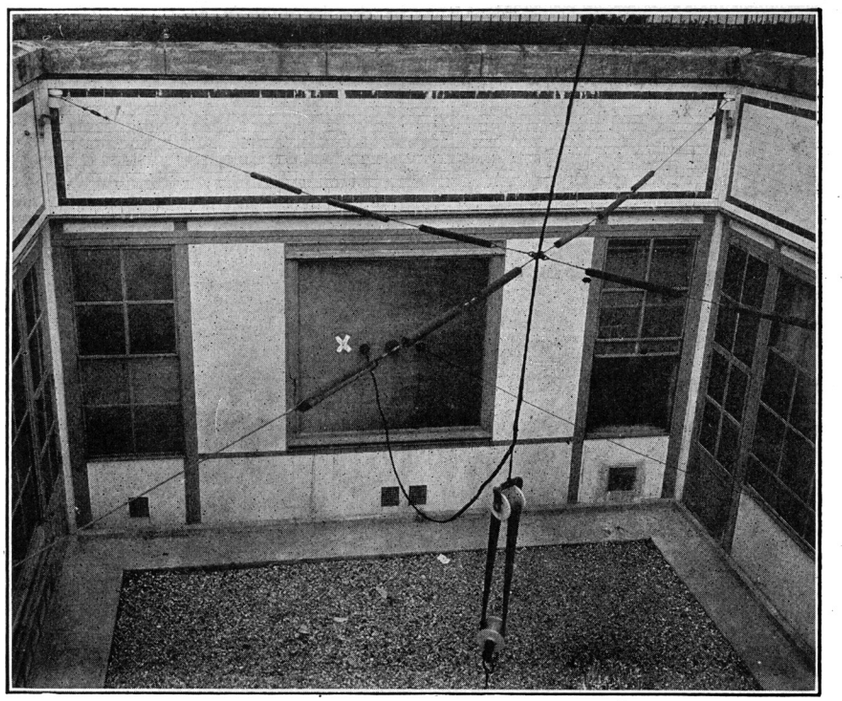
In the case of the frog's leg, for instance, as here employed, it has been found that the production of energy is many times more than the energy involved in the stimulus employed. Thus, in the familiar experiment with a frog's gastrocnemius, the mechanical work of the muscles called forth, is about *38 times the active force involved in the stimulus.* In other words there has been effected an amplification of 38 times the initial energy. It looks, therefore, as though all the ambitious *Radiobugs* will have to move to the country, where the *gastrocnemius* proceedeth to multiply and fatten to sufficiency.



How a Frog's Leg Muscle May be Used to Record Radio Signals. It Amplifies 38 Times!

Lead-in of the Eiffel Tower at Paris, France

The accompanying illustration brings out some practical features in the guying and insulating of lead-in terminals from large radio antennas. The particular one here shown is that at the base of the powerful Eiffel Tower radio station at Paris, France.



The Lead-in Arrangement at the Eiffel Tower Radio Station in Paris, France. Note How the Stranded Cable Is Guyed by Insulators to Keep It Away from Walls. Lead-in Is Taken Into Radio Room Thru Sheet of Insulation.

Radio experimenters in general manifest a marked tendency to employ any old makeshift for a lead-in. On the other hand this is one of the most important parts of any radio station, especially where transmitting apparatus is used, as the high voltage current always tends to dissipate a large portion of the outgoing energy before it reaches the antenna proper, and in this way reduce the efficiency of the station a very appreciable degree.

In the illustration here presented, it will be noted that the lead-in, which is constructed of a number of fine wires stranded together, is guyed from four directions with a number of high voltage insulators connected in series in each guy wire. The vertical tension on the lead-in cable is taken up by two large spool insulators, as shown, which are joined by an insulating strand of pure rubber.

The lead-in cable goes to a metal rod passing through the panel in the side wall of the radio room, the panel being constructed of hard rubber. For small stations it is very good practice indeed to have a metal rod locked in position at the center of a hard rubber or glass panel about one or two feet square. In this way the leakage co-efficient is rendered extremely low and thus the efficiency of the station is kept high. It is indeed surprising, upon visiting a great many experimental and wireless stations, to note the extremely flimsy and inefficient lead-in arrangements their owners will tolerate. A stranded lead-in terminal, equal in conductivity at least to all the multiple wires in the antenna, should be used in every case where the best possible results are desired.

HEAVY INCREASE IN SPANISH RADIO BUSINESS.

The traffic of the Spanish International Wireless Telegraph Company has increased from an average of 800 words per day before the war to an average of about 6,000 words, exclusive of diplomatic correspondence, through the monopoly it enjoys in the transmission of wireless messages from abroad.

The Spanish company has two receiving stations, one at Barcelona and the other at Aranjuez, near Madrid. They receive French news from the Eiffel Tower and from Lyons, German news from Nauen and Norddeich, British news from London and Carnarvon, Austrian news from Pola, and Italian news from Coltano. All the communiques and bulletins from the powers of the Entente are printed on yellow paper and those from the Central powers and their allies on blue paper. The bulletins are distributed to the press and to other subscribers three times per day, at meal hours.

ALL RADIO HEROES ARE NOT FOUND AT SEA.

In a recent number of the *American* magazine a wireless operator tells of the bravery of a radio operator in a shore station.

"Recently a terrific storm was raging along the coast. The Marconi operator at the Astoria, Oregon station, realized that he was apt to be killed at his post by lightning at any moment.

"Did he go away from his post because of his danger? Needless to say, no. The sea was breaking heavily and a hurricane was blowing furiously. This operator was watching over the lives of those at sea that night. Finally lightning struck his aerial.

"The young man, by what seemed almost a miracle, suffered only a few severe burns. The telephone, telegraph, and power lines were completely burned out. Never yet has a wireless operator failed in his duty to humanity on land or sea.

"As the citation of the Astoria incident shows, not all radio heroes are found at sea."

Rotary Spark Gaps

In these days of radio telegraphy the use of rotary spark gaps has become very

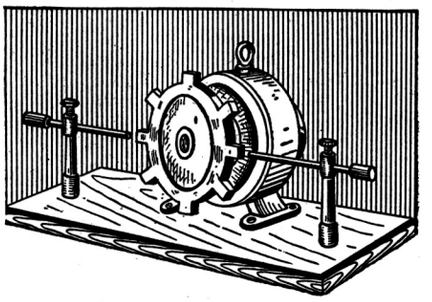


Fig. 1. First Form of Rotary Spark Gap Here Discussed.

extended. There are a great number of different type gaps on the market, some of them very efficient, and some of them inefficient. It is the purpose of this article to point out the advantages and disadvantages of a few of these rotary gaps, as shown by actual experiments.

TYPE 1.

This is the simplest form of rotary gap, and is more or less crude in design. It is operated by a small battery motor on four or more dry cells. As the principle of design is wrong, the results obtained with this gap are never very satisfactory. The spark obtained is very ragged and almost impossible to read, while the tone is low and unsteady. Fast and accurate transmission with it is an impossibility. By overloading the motor with batteries and thus running it at an excessive speed, the tone and spark are improved, but of course the excess current is liable to damage the motor. The trouble with the design is simply that the sparking points are too far apart for the revolutions of the motor.

TYPE 2.

This is similar in design to type 1, but of better design and more efficient. The sparking points are more numerous and the scallop effect in design gives a less abrupt break and consequently a steadier spark. The increased number of sparking points also gives a higher tone than type 1. A well-designed motor runs this rotary gap and it will operate on 110 volts d.c. or a.c. The gap can be used with good results up to about 1 k.w. While not recommended for long distance work, this gap is efficient and satisfactory for ordinary use.

TYPE 3.

This is a very good type of rotary gap, well designed and very efficient. In method of operation it is very similar to type 2, but is of improved design. It permits of very close adjusting of the electrodes to produce a clear spark, and the

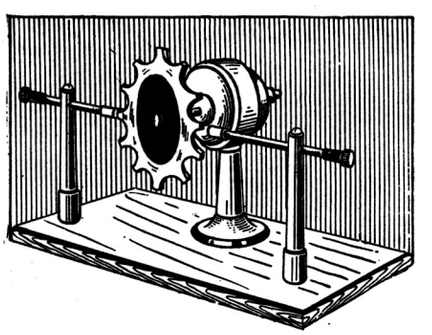


Fig. 2. The Scallop Effect Gives a Less Abrupt Break in Sparking.

high speed a.c. motor gives a very clear tone. It is very efficient for long distance work and operates successfully on powers up to 1 k.w.

TYPE 4.

This is without question the most efficient and satisfactory rotary spark gap in use in modern radio telegraphy. The motor is of exceptional design and is furnished for 60 cycles or any other frequency at any voltage. The gap consists of two rotary quenched spark gaps in series, formed by two semi-circular stationary electrodes placed in front of the circular rotating electrodes, the spark occurring between one stationary and one rotating electrode, and thence to the remaining stationary electrode. The faces of the electrodes have slots milled in their surfaces, leaving radial projections from which sparking ensues, at the rate of 25,000 condenser discharges per second. The radial projections

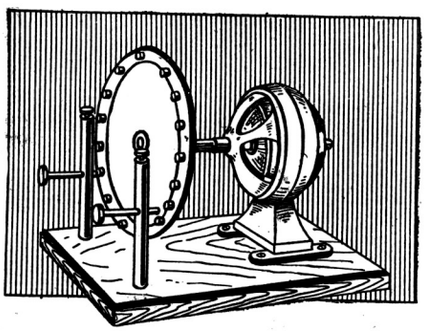


Fig. 3. One of the Simplest Yet Most Efficient Rotary Spark Gaps.

are used simply to break these discharges into groups corresponding to the tone desired from the set, as the discharge rate is so high that it approaches the limits of audibility. It will be seen that by varying the speed of rotation and thus the rate at which the sectors pass, any desired tone is produced. The efficiency of a transmitting set with a rotary gap of this design is from 60 to 70 per cent., which is very good. The tone produced is very high and

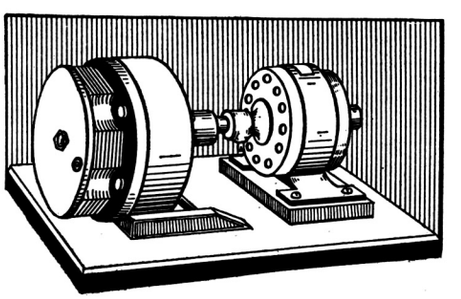


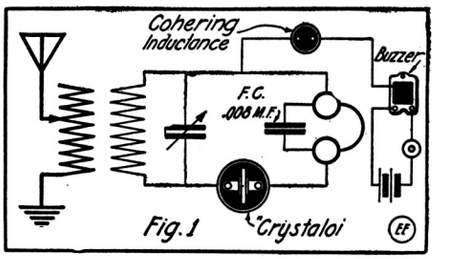
Fig. 4. The Rotary Quenched Gap Is the Most Efficient Type Ever Brought Out, Giving a Hy-Note on Low Frequency A. C.

piercing, resembling a clear whistle, easily read through static or interference, and is readily distinguished when used for long distance work.

SOME HINTS ON THE CRYSTALOI DETECTOR.

I have found out in the two years during which the Crystaloi detector has been on the market many things that are not embodied in the directions accompanying it. These things I have discovered by constant experiments in trying to gain improved results.

To begin with I learned that one hundred feet of No. 26 S.S.C. copper magnet wire wound on most any size tube and inserted in the *buzzer test circuit* as shown in hook-up Fig. 1, would cohere the alloy more closely, reduce the internal resistance and cause the detector to be much more sensitive. This *cohering inductance* appears to cause the finely divided alloy particles to become slightly "welded" to the sensitive mineral which the instrument contains. The "welding" of this alloy

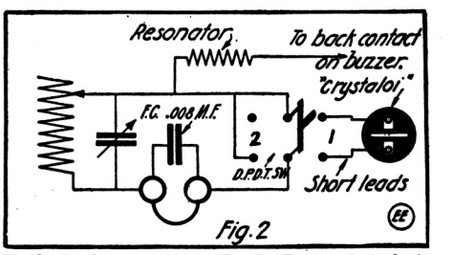


Best Hook-Up for the Crystaloi Detector, with Buzzer Test Connections and Condenser Value.

causes the detector to keep its adjustment to a marked degree. This cohering inductance is needed only with the type O, the larger types having it incorporated in the instruments. It has also been found through actual tests that a stopping condenser shunted across the 'phones and having a capacity of .008 M.F. makes a vast difference in the way of improvement. Condensers of lesser capacity are not nearly so efficient. It is absolutely necessary to employ a buzzer with the Crystaloi.

Variable condensers, no matter where used, should be set at zero when bringing the detector in, otherwise one will have difficulty in adjusting it. It is also necessary to have about one half of the inductance of the secondary circuit in use when setting the detector to maximum sensitivity. The primary inductance does not matter. In practice I find it better after one has secured a very sensitive position, to turn the cylinder in the opposite direction about one quarter of a turn. This also assists in maintaining permanent adjustment.

Many amateurs complain that the Crystaloi detector loses its adjustment when the transmitting apparatus is in use. This difficulty I experienced myself and after a long series of experiments I found the reason for this was due to the fact that any wire left connected to the detector, while transmitting, acted as a miniature aerial. This would pick up the waves from the transmitter and pass them through the detector, thereby destroying the adjustment by burning off the points of alloy in contact with the mineral and sometimes it would even destroy the mineral entirely, thereby causing the detector to lose its sensitivity. To obviate this I arranged a D.P.D.T. switch in the secondary circuit of the receiving set in the manner shown in hook-up at Fig. 2. When transmitting, the switch should be thrown to the position marked 2. This cuts out the detector entirely and closes the secondary circuit, so as to form a path for the stray oscillations that would otherwise enter into the detector circuit. *The short-circuiting of any detector, while sending, is about*



Method of Connecting D. P. D. T. Switch to Protect Crystaloi Detector While Transmitting.

the worst thing one can do, as it provides a complete path through the detector for all stray currents.

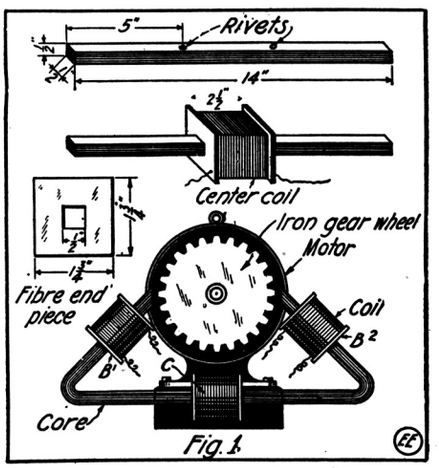
Contributed by ERNEY T. TUGENE.

THE CONSTRUCTOR

An Inexpensive High-Frequency Alternator for Testing Crystal Detectors

By Raymond Francis Yates

DOT-dash-dash-dash-dot . . . 000000000. "Curses! There goes that detector and Sayville sending baseball returns! Curses and more curses! Now the buzzer test is 'on the bum.' Say, Bill, can't we over-



Design for Small High-frequency Alternator Suitable for Testing Radio Detectors and Other Work.

come this trouble some way? This is the third time that junk of a buzzer has failed. I'd give ten dollars for a good testing outfit that would be reliable."

"I 'doped out' a corking good idea the other day, Jim, on a testing outfit using a small high-frequency alternator in place of a buzzer."

"That sounds good, Bill, let's try it."

The proper adjustment of crystal detectors by the utilization of a buzzer is very unsatisfactory in many ways. If the current from the buzzer is too strong it will tend to "burn" the surface of the mineral and thereby reduce its sensitiveness. Aside from this the adjustment of the tone of the buzzer is difficult to maintain and many times fails to function at a critical time.

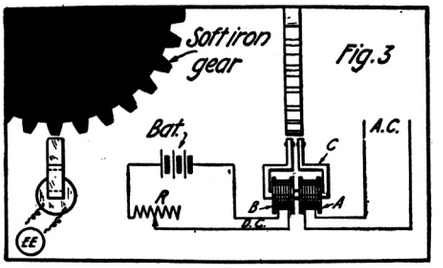
The high-frequency buzzers on the market are quite expensive and in many cases do not perform any better than an ordinary buzzer when it is adjusted to a high note.

The following description will enable any amateur, who is possessed of a small, high-speed battery motor, to construct an apparatus that has many advantages over a buzzer of any type. It is a high-frequency alternator of the most simple design and which will generate a current that is perfectly flexible both in frequency and volume. The delivered current can be changed from 500 cycles to a frequency that is far beyond audibility by merely changing the speed of the motor used by means of a small rheostat. The value of this apparatus, in the adjustment of crystal detectors, will readily be realized.

First, obtain a small iron gear-wheel of about 2½ inches in diameter and take it to a blacksmith shop and have it annealed. After the wheel is thoroughly annealed, fasten it to the end of a small, high-speed battery motor so it will run true. If the hole in the center of the gear-wheel is too large for the shaft of the motor, it can be plugged up with a brass plug and redrilled to fit. Next, cut enough transformer sheet iron 14 inches long to build up a pile ½ inch square. Rivet these together in two places as shown. Exactly in the center of this core wind a coil consisting of about 100 turns of No. 20 S.C.C. copper magnet wire. Fibre end pieces are cut as shown and used to keep the wire in place. Six of these will be needed. Now place the core in a vise and bend up the ends as shown in the sketch. This can be done with a mallet. Then put in two more rivets to prevent the ends from spreading. Slip the fibre ends over the core and wind coils B^1 and B^2, on each end of the core. Each coil consists of 100 turns of No. 22 S.C.C. magnet wire. A few inches is left on each end of the wire. Cover all the coils with linen tape and a coat of shellac. Provide the motor with a neat oak base and connect up four binding posts as shown. Mount the core on the base so that its poles will come as close as possible to the gear-wheel. This can best be done by filing the ends with a suitable half-round file. The apparatus is now ready for use and is connected as shown.

Referring to the diagram, it will readily be seen that by exciting the coil C a current will be induced in the coils B^1 and B^2. If the gear-wheel is revolving between the poles of the core, each tooth will alternately be a north and south pole and an alternating current will be set up in the circuit containing the coils B^1 and B^2. The frequency will depend on the speed of the motor and the quantity will depend upon the amount of current flowing in the circuit containing the coil C. The alternating current from the coils B^1 and B^2 is led directly to a small inductance coil that is placed in proximity to the ground wire, thus inducing a high-frequency current therein by induction.

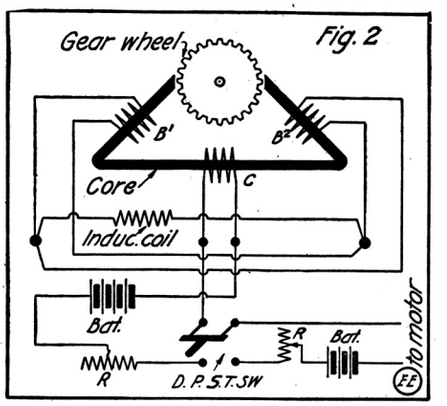
By studying the wiring diagram it will be seen that the D.P.S.T. switch is used both to close the motor circuit and also the exciting circuit of the coil C. The



Simple Form of High-frequency Alternator Comprising Two Coils on a Laminated Iron Core, Mounted Before a Revolving Gear Wheel.

coils B^1 and B^2 form an independent circuit which is directly connected to the small inductance coil near the ground wire.

[*It is usually preferable to have the field pole-face pitch equal to the width of the gear tooth. An optional scheme for constructing a small high frequency alternator is illustrated at Fig. 3. The two coils A and B may correspond in turns to those*



Connections of Stationary Coils of Alternator, Including Excitation Control Circuits.

cited above, using wire several sizes smaller. The coils are wound on the laminated (sheet iron strip) core C, the pole shoes of which are bent after the coils are in place. One coil magnetizes the core as becomes evident. The other coil has alternating currents induced in it and is connected up in the same manner as indicated at Fig. 2.—Editorial Note.]

AN INTERESTING HINT FOR COIL USERS.

Beginners in electrical science often experience a difficulty in understanding the character of the current supplied by the secondary winding of an induction coil. While it is generally known that the induced current is alternating—flowing first in one direction and then in the opposite—a difficulty arises in connection with the polarity of the secondary terminals. The coil is connected with a geissler vacuum tube, let us say, and it is observed that the results are different when the polarity of the tube is charged. How is the student to reconcile the two facts? With an alternating current one naturally expects the polarity to reverse with each pulsation. The explanation is very simple. While the current induced in the secondary winding of a coil is certainly of an alternating character it is stronger in one direction than in the other. The highly attenuated gas which remains in a vacuum tube offers a considerable obstacle to the passage of electricity, an obstacle too great to be surmounted by the weak current but one that the more powerful current in the opposite direction is able to overcome. Hence the tube is traversed by the induced current in one direction only, thus accounting for the fixed polarity as evidenced by the characteristic glow at each end.

Contributed by H. J. GRAY.

A New Design for a Chromic Acid Battery

By C. A. Oldroyd

THE chromic acid battery is by far the best to use where a heavy current is required. The usual objection, however, is that this battery is rather "messy" and troublesome as the zincs have to be removed when not in use and the electrodes are difficult to clean.

It is, furthermore, a well-known fact that the chromic acid solution quickly loses its depolarizing power if it is not kept in motion. Thus the same solution if kept circulating through the battery, will keep the current at a much higher point than if the liquid was at rest. The following will show the experimenter how to make a simple circulation battery, furnishing a current almost as steady as that of a storage battery.

In the design described below these difficulties have been overcome and the battery will be as simple to use as a storage battery.

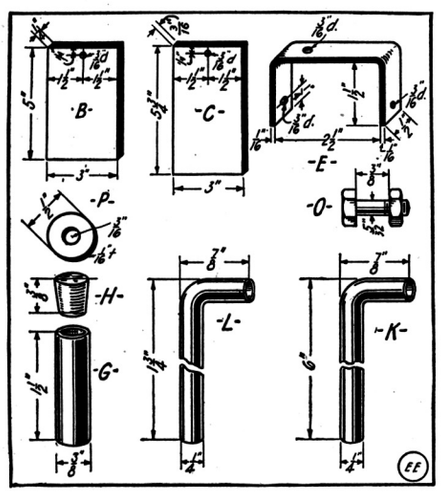
The battery consists of a glass jar, A, containing two carbon electrodes, B, and a zinc electrode, C, between them. The two carbon electrodes are connected by means of the copper strip E which carries a binding post, F.

The zinc electrode also has a binding post, I. The carbon and zinc electrodes are held in position by the black wax, D, which was cast into the jar. Two small glass tubes, M and N, penetrate the black wax and it will be seen that one tube, M, ends just below the wax, while the other tube, N, reaches down to the bottom of the vessel.

These glass tubes, M and N, permit the chromic acid to circulate through the battery.

This is accomplished in the following manner.

The diagram shows a number of batteries joined up; in this case six batteries. All tubes, M and N, have been connected with each other; that means M of one battery with N of the next and so on. The chromic acid is contained in a big glass jar, S, and brought into the first battery by means of a syphon, T, made from a glass tube and some rubber tubing. As the glass jar, S, is about 2 to 3 feet above the inlet the chromic acid will pass through the series of batteries forced by the head of fluid. After leaving the last battery of the series it passes through some rubber tubing and glass tube, Y, into a second glass jar, R, which serves as a receiver. This



Various Component Parts Making Up a Chromic Acid Cell of the Type Here Described.

continues as long as there is sufficient chromic acid in the first jar, S.

The question is now: how are we to bring the chromic acid back to the first jar, S?

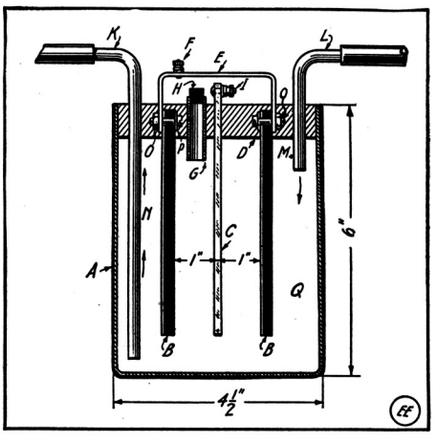
This is done by connecting the two jars by tubing and two glass tubes, L and V, and by forcing air into R by means of a small cycle pump, W, which is connected to R by a glass tube, X, and a short length of rubber tubing.

The drain from the last battery is temporarily closed by means of a pinchcock, which was slipped over the rubber tube. A few strokes of the pump will be sufficient to create a slight pressure inside R and force the chromic acid back into S by way of L, the rubber tubing and V.

After this, we start the syphon again by closing the tube, U, which passes just through the cork stopper and enables the outside air to enter S for a moment and a few strokes of the pump, W, will be sufficient to force the acid up the tube T. We open now U again and the chromic acid will take its old course through the batteries into the receiver jar, R.

As seen from the foregoing it is not at all necessary to come into contact with the acid, yes it is even impossible.

To clean the batteries after use we simply connect the inlet of the first jar to the water main and the outlet of the last jar



Detailed View of Assembled Chromic Acid Battery Cell with Carbon and Zinc Electrodes in Place.

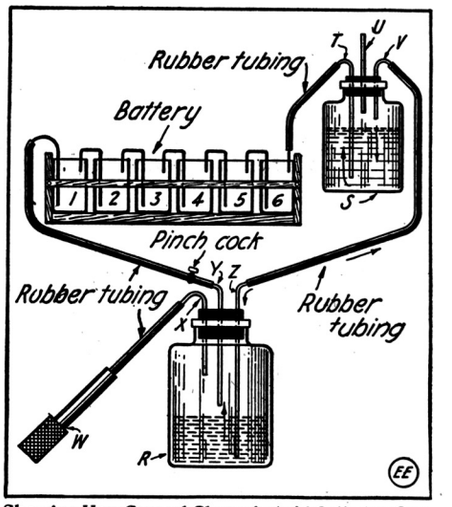
to the drain and pass a stream of water through the batteries which will leave them in first class condition till they are used again. Thus no zinc can be used up while battery stands idle. The construction of the battery will now be described in detail. Most of the parts are standard and can be easily procured from electrical stores catering to the experimenter.

The carbon and zinc electrodes should be procured first. The carbon electrodes measure 3 inch by 5 inch and are ¼ inch thick. A hole 3/16-inch diameter is then drilled ¼ inch from the end to take the screw O. The zinc plates measure 3 inches by 5¾ inches and are 3/16 inch thick. A hole 3/16 inch is drilled through the zinc plates similar to the carbon electrodes. The connecting strip, E, is made from copper strip ½ inch wide by 1/16 inch thick and bent to the dimensions given. Three holes 3/16-inch diameter are drilled in the positions shown, two of them to take the screws O and one on top to take a binding post, F. The screws, O, and copper washers, P, can be bought from electrical stores.

The carbon electrodes, B, and connecting strip, E, can now be assembled.

We turn next to the glass tube, G. This is ⅜ inch in diameter and 1½ inches long, and has a stopper, H, which fits it tightly. This glass tube should be closed when working, it is only used to dry the batteries after cleaning by removing the stopper.

The glass tubes, M and N, are made from



Showing How Several Chromic Acid Cells Are Connected Up so as to Permit of Readily Circulating the Electrolyte thru Them with a Bicycle Pump.

tubing ¼ inch in diameter and are bent as shown.

These tubes can be bent easily in the flame of a Bunsen burner.

The carbon and zinc electrodes and tubes must now be cast into place.

The easiest way of doing this is to cut a board which fits over the glass jar and has a few slots and holes to hold the plates and tubes in the position required; also another big hole to allow the black wax to be poured in. We place the board with the plates and tubes over the jar, A, and fill the jar with water up to ¾ inch from the top. After having dried the inside of the jar (this is important) above the water we pour a thin film of molten paraffin wax about ⅛ inch thick on top of the water and upon this molten black wax such as used for sealing accumulators till flush with the top of the jar, A.

The battery is now completed and we drain the water out of A through the glass tube, M.

After the number of batteries required have been made we assemble them in a wooden box and connect the tube, M, of one jar to the tube N, of the next one by means of rubber tubing, K and L.

Two five-gallon jars, R and S, are next required and fitted with cork stoppers treated with molten paraffin wax to make them acid proof. The glass tubes, T, U, V, X, Y and Z, are made from tubing ¼ inch diameter and bent to suit position of jars. The jar, S, should be placed 2 to 3 feet above the battery and R about one foot below. We connect finally the cycle hand pump, W, to the tube, X, and our battery is complete

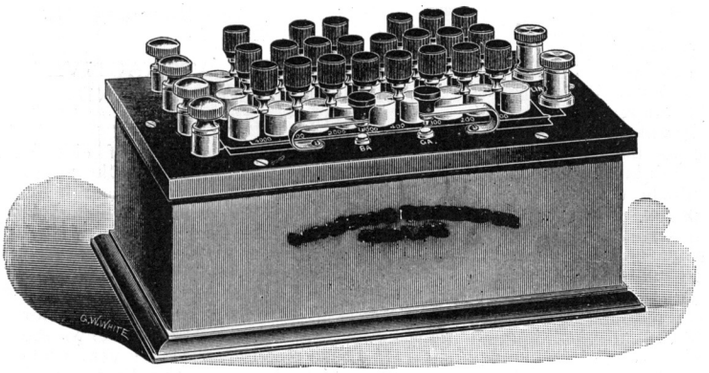
The best solution for use in this type of battery is prepared as follows: 7½ parts of Bichromate of Sodium, 15 parts of concentrated sulphuric acid mixed with 200 parts of water.

This battery has a voltage of 2 volts per cell and gives a current of about 20 amperes; it is, therefore, very suitable for running spark coils and motors from it, in fact for all experiments which require a large current.

It should be understood that after a certain time the chromic acid loses its depolarizing power (as evidenced by the decrease of current generated); then the liquid must circulate farther and farther until exhausted entirely.

Construction of a Wheatstone Bridge for Measuring Resistances

The following is a brief description of a simple, yet comparatively accurate Wheatstone bridge that the Experimenter will find to be useful in many ways.

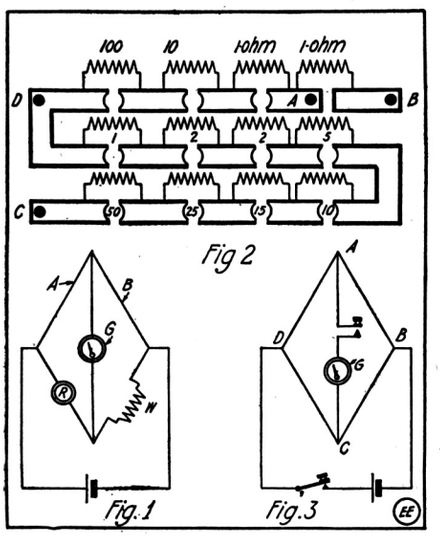


Commercial Form of Wheatstone Bridge for Measuring Resistance Similar to the Type Here Described.

The materials required are easily procurable at but little expense. First secure half a pound of No. 30 S. C. C. copper magnet wire, and if possible borrow a calibrated bridge and measure off lengths of wire of 1, 1, 1, 2, 2, 5, 10, 10, 15, 25, 50, and 100 ohms resistance. If unable to secure the bridge take some instrument of known resistance such as a Bell telephone receiver (75 ohms) and find by trial a length of the No. 30 wire whose resistance is exactly equal to the receiver.

This may be done by using a hook-up as indicated in Fig. 1, where A and B are equal lengths of wire, R the receiver, W the wire whose resistance is to be exactly equal that of the receiver, and G a galvanometer. When the galvanometer needle remains exactly in the center the two resistances are equal. Do not leave the battery connected directly in the circuit but connect it just long enough to take a reading of the needle deflection. Measure the length of the wire carefully and from this information cut off the required lengths. A somewhat less accurate instrument can be made by using the approximate resistance value of 1 ohm per 9.686 feet of wire.

Having made up these resistance coils, secure three strips of ¾ x ⅛ inch brass, 7½ inches long to be drilled and cut as shown in Fig. 2. Place binding posts as



Arrangement of Resistance Coils of Known Value in "Bridge," and Circuits for Testing Resistance.

shown, connect the coils in the right order with solder and make some tapered metal plugs to fit the holes. These plugs can be turned out of brass or can be made as described on page 38 of THE ELECTRICAL EXPERIMENTER for May, 1916. The galvanometer can be purchased or may be constructed after any of the designs as described in previous issues of this journal.

To measure the resistance of any coil, wire, etc., connect it across the binding posts C and B (Figs 2 and 3) and with a plug out of the ratio coils (that portion included between posts D and B), remove enough plugs from the resistance coils to equal what you judge the unknown resistance to be. Then press *first the battery key and then the galvanometer key* (always in this order), noting the amount and direction of deflection of the galvanometer needle. By removing or replacing plugs, vary the resistance until upon pressing the keys the galvanometer needle remains in the center. Add up the resistances indicated by the removed plugs and from this and the ratio in the ratio coils the unknown resistance can be determined. If the ratio coils were set at 1 to 1 and 28 ohms resistance was in circuit the unknown resistance would then be 28 ohms. If the ratio was, say 1 to 10, the resistance would be 280, and if 1 to 100 it would be 2,800 ohms. In this way resistances up to 11,000 ohms can be measured.

Be sure the plugs are secure in their sockets, as loose plugs increase the resistance, giving rise to errors. Also do not handle the plugs, as a little grease from the hands will increase the resistance and lower the accuracy of the instrument. If properly constructed this instrument can be made to measure resistances with a very slight error; surely within the limits required in the calculation of any ordinary circuits.

The instrument can be mounted in any suitable box preferably with the brass plates screwed to the top, and the galvanometer face projecting, or separate, as desired.

A NOVEL TELEPHONE RECEIVER.

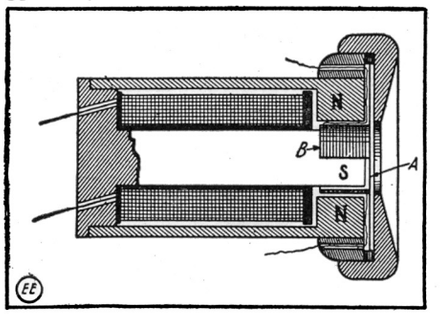
For some time past there has been considerable development in magnifying the sound from receivers using some sort of moving iron armature, but little has been done toward applying other, yet possibly better principles. A definite amount of electrical energy entering a receiver cannot produce quite that amount of mechanical power in the form of sound, yet the ordinary receiver has been made more sensitive by the addition of mechanical levers and light diaphragms. This shows that the efficiency could not have been very high in the first place, and if the mechanism could be simplified a still higher efficiency should be expected.

The following description of a new receiver, using an old principle, should prove of interest in wireless work, especially where low voltage circuits are to be used.

On the lower side of a thin mica diaphragm (A) is mounted a coil of fine wire (B) wound on a paper cylinder about ⅝ inch in diameter and about ⅜ inch long.

This moving element is mounted so that the coil will be free to vibrate up and down the cylindrical air gap between the poles of a permanent or electric magnet, one pole of which is the end of a round rod (S) extending up into the paper cylinder, and the other pole (N) completely surrounding the outside of the paper cylinder. Two leads from the moving coil connect with the radio receiving or telephone circuit.

The only losses this receiver can have apparently are molecular friction in the dia-



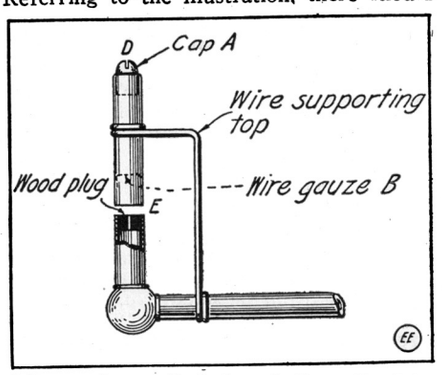
A [Moving Coil Telephone Receiver Having a Magnetizing Coil for Polarizing the Iron Frame.

phragm and air and the electrical resistance of the receiving coil. There is no hysteresis loss, and practically no eddy currents. Although a very small current would move the diaphragm when the coil is working in a strong field, it would not operate so rapidly as when in a weaker field. In its simplified form only a small amount of wire can be used in the moving coil. A receiver like the one here described having about 36 ohms of No. 40 enameled wire on the moving coil was built and found to be very sensitive, but as there were no delicate instruments at hand, a thorough test could not be made. It is worthy of further experimentation.

Contributed by A. J. WILLAT.

GAS HEATER FOR SOLDERING IRON.

Having need for a heater for a soldering iron, the writer made a cheap Bunsen burner in the following way: Unscrew the end of the gas jet and remove the tip A and the wire gauze B inside. As the principle of the Bunsen burner is the mixture of the gas with air before ignition, an opening must be made to admit air. This is done by raising the pipe about 1/16 inch above the rest of the jet. As the hole in the jet is too large for sufficient gas pressure, this can be made smaller by putting in a wood plug and piercing it with a small hole. The flame then generated at D should be blue, with a slight tinge of white at the top. If the flame should burn with a hissing noise, the hole is too small. Referring to the illustration, there should



A Bunsen Burner Made from Ordinary Gas Jet.

not be any flame at E, only at D. If the opening at E becomes too large, the burner will flare back and a flame will appear at that point.

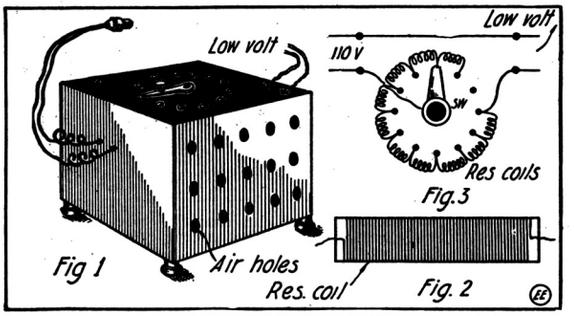
This burner will be found very suitable for heating a soldering iron.

Contributed by T. O. WOHLSEN.

A Rheostat for 110 Volts

Following are the details for the construction of a rheostat or current reducer, which if built with care will be found to be absolutely safe and efficient and which will provide current for practically all low-voltage apparatus. It can be used satisfactorily on either alternating current or direct current circuits.

The necessary materials are: One box 7x5x4.5 inches (preferably metal with wood



Details for Constructing a 110 Volt Coil Type Rheostat. The Same Idea Is Applicable to Larger Size Units, or for Different Voltage Connections.

or slate top), 100 feet of No. 26 bare Nichrome resistance wire, one broomstick, one square yard of heavy asbestos sheeting, one miniature switch lever, 12 contact points, four binding posts, two dry-cell binding posts, several tacks, a short piece of insulated wire, one attachment plug and eight feet of lamp cord.

Line the box with two or three layers of asbestos sheeting. Then invert it and in the exact center fasten the switch lever. Arrange the contact points in a circle around it. Mount the four posts as indicated in the figure. With insulated wire connect as shown in diagram, Fig. 3. (The wiring is on the inside of the box, of course.)

The resistance units are now to be constructed. Saw four pieces from the broomstick, each 6.5 inches long. Cover these with three or four layers of asbestos sheeting, holding the layers in place by a tack partially driven in at each end. Wind several turns of the resistance wire around one of these tacks and then proceed very carefully to wind the coil. About 80 turns can be taken without toucing one another. This will be about 25 feet. Wind the wire several times around the other tack and then drive both in. This will hold the wire secure. Construct three other coils in exactly the same way. In the middle of one of the coils loosen a turn and fasten a piece of insulated wire to it. With the other coils, however, an insulated wire is fastened 1-3 of the way from one end and another is fastened 1-3 of the way from the other end. This is the only way in which one of the coils differs from the others.

Fit the coil (with a wire leading from the middle) in a lower corner of the box. Drive a tack into each end to hold it secure. Then connect the wire at one end of it to the dry-cell post to which only the lamp cord is connected. Then fasten the insulated wire in the middle of the coil to the contact point numbered 1. Fasten the wire at the end of the coil to contact 2. Fit in another coil. Connect one of the end wires to the end wire of the other cell which was fastened to contact 2. Then proceed in the same way as was done with the first coil, fastening the insulated wire 1-3 of the way from that end to contact 3, and so on. When the four coils are installed, an amperage ranging from 4 to ½ can be drawn, the highest from contact 1 and the lowest from contact 11, contact 12 being neutral. Fasten the lid on, then bore several holes in different places in the box for ventilation. A coat of varnish will greatly enhance the appearance of the instrument. A drawer-pull can be fastened on one end for convenience in carrying.

The wide range of current will be sufficient for nearly all apparatus. It should be stated, however, that small 2 to 3 volt Mazda lamps will burn out if used on this rheostat. Regular 14-volt bulbs (the same as used for headlights on miniature locomotives) should be used.

Should the experimenter have but little use for the 4-ampere current, No. 30 B. & S. Nichrome wire will be very satisfactory. If this size is used, only 35 feet will be necessary.

However, if the 4-ampere current is to be used for long periods it will be best to wrap asbestos sheeting on the coils. The ventilation holes should be enlarged also. For the safest operation the rheostat should be made entirely of slate and metal (tin of black stovepipe iron riveted or soldered). Also, it should rest on four porcelain knobs.

Eighteen per cent. or 30 per cent. German silver wire may be used instead of Nichrome wire. If 18 per cent. wire is used 300 feet will be necessary; if 30 per cent. wire is used 200 feet will suffice. Any other wire with a resistance of one ohm or over per foot may be used. However, it is best to use the Nichrome wire if it can be obtained.

The rheostat described above will not heat up excessively if used for ordinary periods.

DIRECTIONS FOR REFILLING GRAVITY CELLS.

1. Draw off the greater portion of the zinc sulphate solution in the old cell by means of a syringe.
2. Remove the zinc and clean ready for use again if sufficient remains.
3. Throw out the copper sulphate solution and clean jar and copper electrode if deemed advisable. If not, throw electrode and crystals away and replace with new, as follows in recommendation No. 5.
4. After jar is cleaned, fill with water up to the lower edge of the zinc, leaving out water to the amount of zinc sulphate solution taken from old cell.
5. Open out the leaves of the copper electrode, place it in position in the bottom of the jar and cover with copper sulphate crystals of proper size (total weight approximately two pounds).
6. Pour in the water mentioned in recommendation No. 4 for old cell.
7. Very carefully pour the zinc sulphate solution mentioned in recommendation No. 1 for old cell, into the cell with as little disturbance as possible.
8. The terminals may be short-circuited until the *blue line* is established, after which the zinc may be removed and cleaned and upon being replaced, the cell will be found in good condition.
9. Add heavy paraffine oil to the surface to a depth of about 5/16 to ½ inch (about six ounces) to act as a seal against evaporation and creeping of zinc sulphate salts.

A HINT FOR RUBBER TUBE CONNECTIONS.

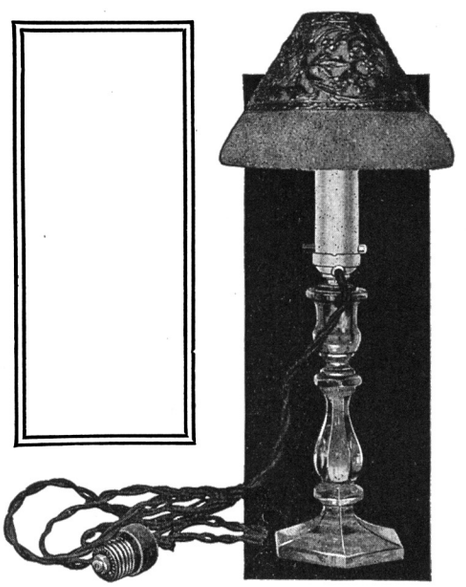
Rubber tubes are always liable to collapse and develop kinks, especially near the ends where they are connected to glass or other tubes. This can be prevented in a very simple manner. Select a rod a little smaller than the outside of the tube. Wind a length of brass wire round it to form a spiral about two inches long; slip this over the rubber tube so as to cover the part where kinks are most likely to occur.

Contributed by GEORGE LESLIE.

HOW TO MAKE ATTRACTIVE ELECTRIC CANDLES AND PORTABLE LAMPS.

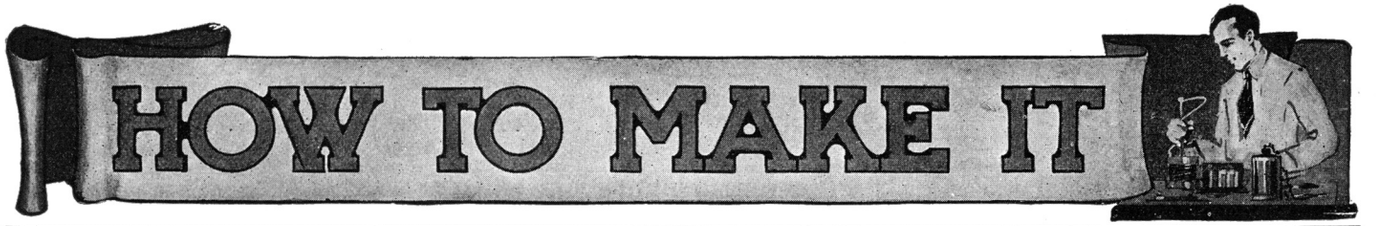
Something new in the way of electric lamp sockets is known as the candle length socket because in place of the usual brass shell of the ordinary standard socket, a white fibre shell in the shape of a candle is employed. This socket can be supported on a glass or other solid candle stick, one of which is shown in the illustration. It is not necessary to do any wiring other than connecting up the lamp cord to the socket. These electric lamps are very pretty for use in the home, on the dining table, the dresser, or mantlepiece. In the position in which the socket is shown in the illustration it will be noted that there is an outlet in the side of the socket cap through which the cord passes. The parts such as the holder and shade can be purchased most any place or you may have them about the house, while the electric cord, lamp and the candle length socket may be secured at any electric shop. The same type of socket can be employed on ceiling and wall fixtures also. For such purposes the cap of the socket does not have the extra side outlet because the fixture wires enter from the fixture through the regular cap outlet.

Where a table or reading lamp is wanted, a new push socket is made which resembles the standard types except that it is arranged so that interior wiring of the fixture on which it is used is unnecessary. A solid wooden pedestal may be utilized, or a



Application of the New Candle Length Socket with Side Outlet Cap on Candle Stick

gas bracket or table lamp converted into an electric very easily. It is only necessary to secure the socket at the top and lead the lamp cord from this socket to any source of electric supply. The result is a serviceable, portable lamp, quickly and cheaply made. The operation is by means of push buttons, the pushing of the light colored button lighting the lamp and the depression of the black one extinguishing it.

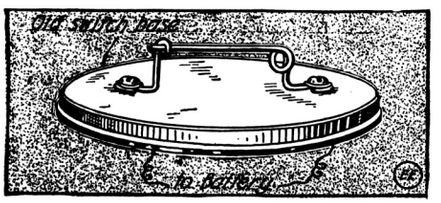


This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00

SIMPLY MADE BATTERY SWITCH.

With six inches of brass or steel spring wire and in as many minutes, one can make this emergency battery switch. Bend the two lengths of wire as shown in illustration and twist the one making contact two or three times around a nail so as



Extremely Simple Battery Switch Composed of Wood Base and Two Bent Wire Members as shown.

to give it more elasticity. An old battery base, properly drilled for the insertion of switch points, may be used if handy.

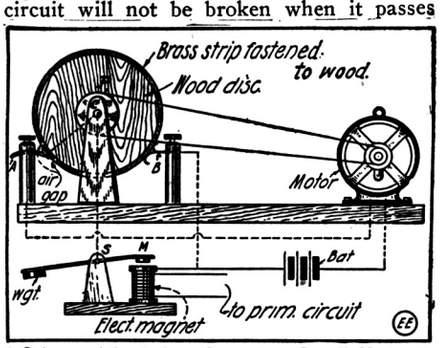
Contributed by JOHN T. DWYER.

ROTARY SWITCH.

It is often desired to operate a small motor to run a recording device by means of a secondary circuit. I show here a simple and effective method of control. The difficulty usually encountered is that of opening the secondary circuit at the end of a message when running a recording telegraph instrument, for example.

In the diagram shown, the motor is started by energizing the small magnet M in the primary circuit in series with the telegraph buzzer or relay. This closes the secondary circuit, starting the motor, causing the disc to rotate. Now when both brushes are on the long strip (see diagram) the circuit remains closed and the message may be sent. When the small segment comes to brush A, the circuit will automatically be opened unless the primary circuit is closed.

The advantage of this switch is that the apparatus is always "set" and never needs to be set at the receiving station. It will be noted that switch A is smaller than the segment, whereas brush B is larger than segment plus insulation gap, so that the circuit will not be broken when it passes



A Scheme Adapted to Operate a Small Motor to Run a Recording Device by a Secondary Circuit.

this brush.

Contributed by L. J. JACKSON.

THIRD PRIZE $1.00

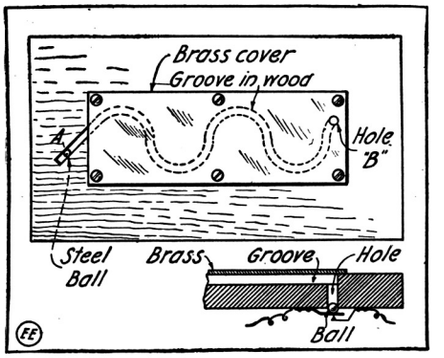
A SHORT CIRCUIT CLOSER.

Take a board 1x3x4 inches and on one side with a hot iron or penknife make a groove, as shown.

Bore a hole through the board in the end of the groove and mount two thin springs under the hole 1/16 inch apart, so that a steel ball dropped through the hole will close the circuit between the two contacts.

With screws or rivets fasten a thin brass cover over the design, leaving a short end "A" of the groove uncovered.

To operate, place a steel ball in the groove at "A" and with a steel magnet trace out the design over the brass cover.

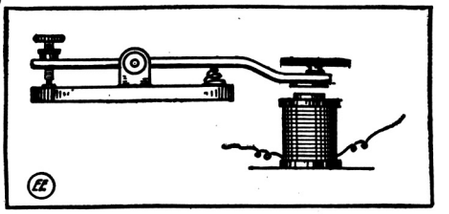


Place a Steel Ball in the Slot at "A," Coax it Along the Blind Groove to "B," where it Falls in Hole and Closes Lock Circuit.

The steel ball will follow the magnet and if the design is traced correctly, will fall in the hole "B" at the end of the trench, closing the circuit. A bell connected in series will be rung, or an electric lock operated. It will be impossible for the ball to follow the magnet if the design is not traced right. The scheme is susceptible of many other designs and details and will keep the "undesirables" out of your tool drawer.

Contributed by PAUL CALHOUN.

CHANGING A KEY TO A SOUNDER OR RELAY.



Making a Telegraph Sounder or Relay from Pair of Electro-Magnets and a Key.

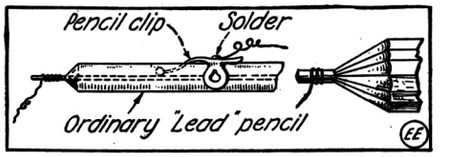
By screwing a small iron bar to the lever, and arranging two magnets below it, a key can be changed into a sounder or a relay. If used as a sounder, the key should be opened about one-eighth of an inch, but for relaying purposes the movement must be very slight.

Contributed by HAROLD RICE.

SECOND PRIZE $2.00

SIMPLE PENCIL RHEOSTAT.

In the June issue I noticed a contribution which was called the *Simplest Rheostat*. Without egotism, I am inclined to think that this idea of mine has something on it for simplicity, in so much as no materials other than the pencil and clip are required.



The Simplest Pencil Rheostat Made by Slotting the Wood and Fitting a Fountain Pen Clip to It.

All one need do is to saw or cut a groove in the middle of the pencil, as shown in Fig. large enough to enable the clip to make contact with the *lead rod* (it may not be amiss to state here that the *lead* in pencils is really graphite, an allotropic form of carbon, possessing high electrical resistance). One battery wire should be soldered to the clip and the other wound around the end of the rod.

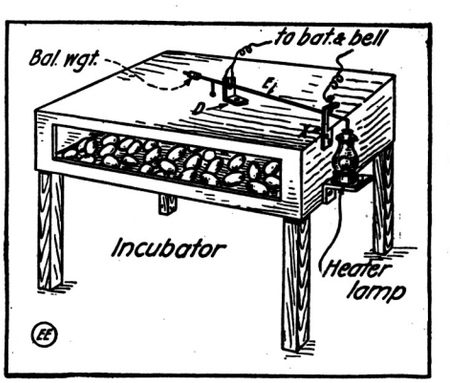
Contributed by JOHN T. DWYER.

ELECTRIC ALARM FOR INCUBATOR.

In this electric incubator alarm scheme one wire from the battery is connected to the fulcrum, D, of the rod on the thermostat if the rod is metal. The other wire from the battery goes to a switch, from there to the bell and then to the metal strip, bent as shown in the illustration at X with a contact screw in the top. This piece is first placed so that the arm makes contact with the bottom when too *cold*. Then the screw is adjusted so that it makes contact with arm E when too hot.

If the arm is made of wood instead of iron, a piece of tin or brass should be bent around the arm at X and a wire run from this to the fulcrum. One battery is usually sufficient

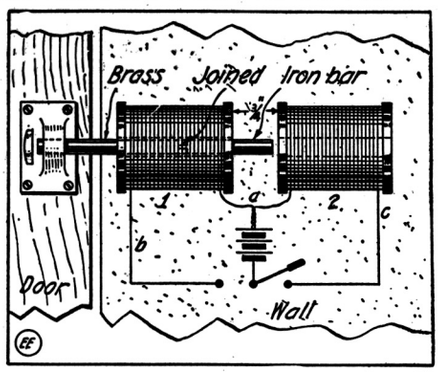
Contributed by DEWEY JOHNSTON.



Electric Alarm Attachment for Incubator Which Rings a Bell at Extreme Hot and Cold Points.

ELECTRIC DOOR LOCK WRINKLES.

Fig. 1 illustrates an electrically operated door bolt which may be constructed from two coils, 1 and 2, with their iron cores ex-



Simple Form of Magnetic Door Lock in which One Magnet or the Other Pulls the Iron Bolt Open or Shut.

tracted, a bar of brass with a short piece of iron attached to it, a few feet of wire, a set of batteries and a switch. Assemble as shown.

To operate, close switch to C and the bolt will slide to coil No. 2 and vice versa to close. Always leave the switch open after locking or releasing the bolt.

Contributed by ADOLPH ZULINKE.

RENOVATING WORN FILES.

The renovation of files can be easily done in this manner: Wash the files with soap, and brush well while washing. Then dip in a solution composed of nitric acid and water, equal parts of each, for about one hour and wash again.

Contributed by AURELIO SIERRA, JR., (Mexico).

A "SHOCK-PROOF" SWITCH INSULATOR.

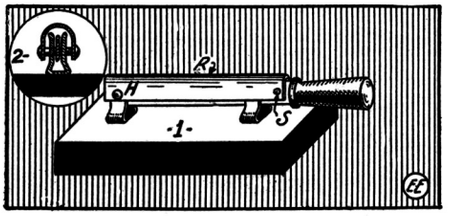
This simple but helpful device lessens the chances of getting a shock or being electrocuted when manipulating knife switches.

Procure a sheet of hard rubber about one-sixteenth of an inch in thickness, which is long enough and wide enough to cover the switch arm as shown in Fig. 1 and 2 at R. The rubber can be bent in the shape shown at R, Fig 1, by immersing it in boiling water, and bending it while hot. In this way the rubber insulates or covers the whole switch arm.

The hinge part of switch shown at H, Fig. 1, should be filed off round so as not to cut the rubber. Bore a small hole in the handle as shown at S, tap it if desired and insert a small screw, or a small bolt will do, with a nut fastened on the other side to retain the rubber.

These insulator guards can be used on a switch with any number of poles or arms, but only of the single throw type.

Contributed by
MELVILLE W. CRANE.



"Shock-Proof" Insulator for Knife Switches. It Is Made of Fibre.

TO MAKE IMITATION FROSTED GLASS.

A frosting mixture to be painted on the glass is composed of sandarac, 18 drams; mastic, 4 drams; ether, 24 ounces, benzine, 16 to 18 ounces. This application cannot be exposed to a high temperature.

Another source says to make frosted glass (imitation) paint the glass with saturated solution of Epsom salt, to which a very little mucilage of acacia has been added.

SOME USEFUL ELECTRICAL WRINKLES.

Herewith are a few ideas which I thought might be of interest to experimenters.

No. 1, is a method I use for twisting wires, such as annunciator wires. It may also be used to unwind them. To wind a cable cut the wires the length desired and fasten to hooks H_1 and HH screwed on a wood stick S. A is a

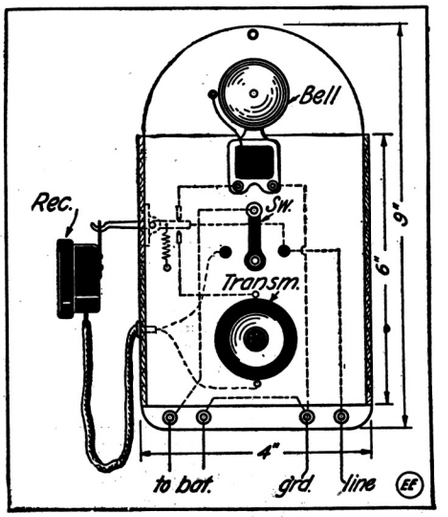
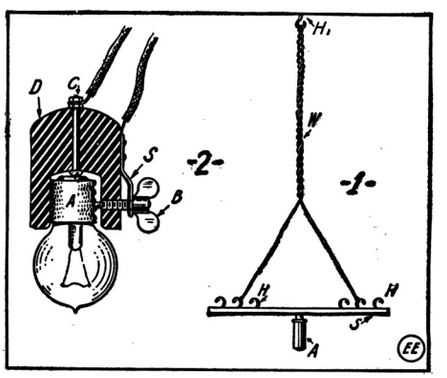


Fig. 3. Telephone Made from Various Standard Parts at Slight Expense.

handle for holding the stick with wires attached. As the winding proceeds, move the wires nearer the center for winding, and farther from the center to unwind.

No. 2, is a miniature lamp socket; D is made of wood, fibre or hard rubber. C is a small screw to make connection, S is a spring which bears against B, a screw from a battery zinc; S is held to D by means of two wood screws.

No. 3 is a telephone set which I constructed from odd parts. As the wir-



Figs. 1 and 2. A Scheme for Twisting Telephone Cables and a Simple Lamp Socket.

ing and connections explain themselves they need no description.

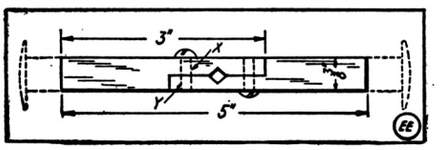
The operation is briefly as follows: The switch normally remains open and hook is closed. When it is desired to call, the switch is moved on right contact a number of times. Then the receiver is taken off the hook which connects the talking circuits when SW is moved from right to left. After the receiver is replaced on hook, switch must not be on either point.

Contributed by W. E. LEACH.

A FIVE-CENT TAP-WRENCH.

Herewith are the directions for the construction of a small tap-wrench, which if home made, should cost not over five cents:

Secure two bolts 4" long and 3/8" thick. Cut them off above the threads and also



Home-made Tap Wrench Constructed from Two Bolts. Drill Tap Holes with No. 29 Drill; Slip Holes with No. 26 Drill.

the top, leaving the rod 3" long. File them as shown in the illustration, tapping the holes marked "Y" and drilling the holes marked "X," so that the screw will fit loosely. Try to be accurate in drilling the holes as success in this case depends principally on this. The screws may be tightened with a screw-driver or knurled thumbscrews can be used if at hand. The square hole section can be case-hardened by heating the bolt ends to a cherry red, then plunging them into cyanide potassium.

Contributed by ELMER E. FANCHER.

USEFUL EVERYDAY HINTS.

No. 1—Few people know this never-failing method for unscrewing a fountain-pen which has stuck for any reason. It can be unscrewed in a second, if a rubber band is wrapped around the end, thus allowing a firm grip to be obtained. It will be found that it will turn very easily, when other methods have failed.

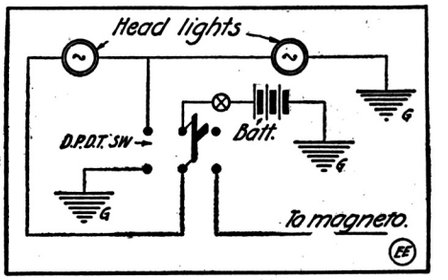
No. 2—How to Make a Casting—For making the mold to cast small articles of zinc, lead, and other soft metals, mix equal parts of sand and plaster of Paris. Allow the mold to set thoroughly and dry it in an oven, for if there is any moisture left, the casting will be spongy or blistered. For large articles, use ordinary moulders' sand, and make it so damp that it will rapidly cohere, but will not stick to the fingers. Dust over the pattern, and along the junctions of the sand, with finely powdered rosin or burnt sand.

No. 3—To drill glass, keep the drill freely lubricated with camphor, dissolved in turpentine.

Contributed by ALFRED H. HUST.

BATTERY CONNECTION FOR FORD CARS.

Ford cars running very slow or coasting down a hill have little or no light to guide them. By using this connection any owner can use either his magneto, by throwing the D.P.D.T. switch to the right, or the battery by throwing the switch to the left. A storage battery, of course, should be used. A rheostat (X) may be inserted between the bat-



Switching Scheme for Ford Cars, Enabling One to Throw Lights on Magneto or Battery.

tery and switch to dim your lights when approaching another car.

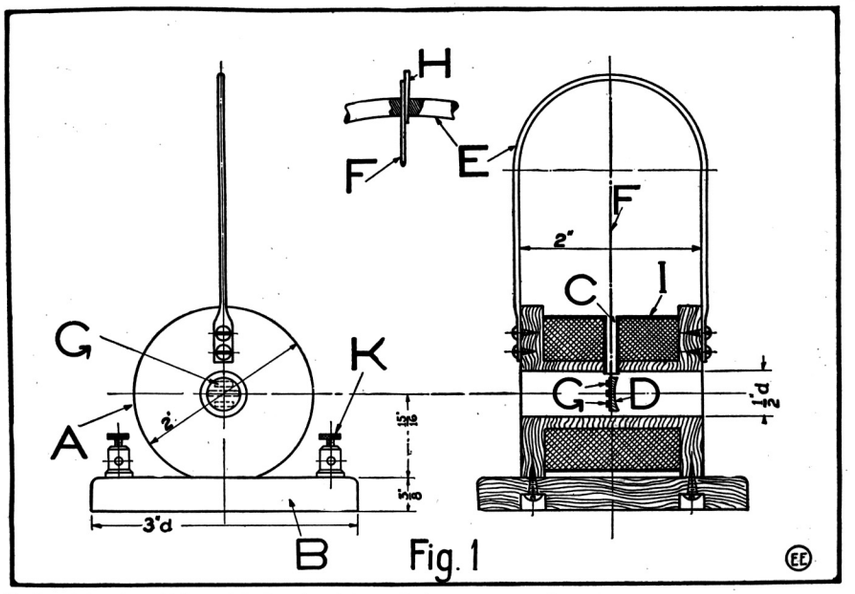
Contributed by G. T. MORGAN.

How to Build a Highly Sensitive Galvanometer

By C. A. Oldroyd

The instrument described here is very sensitive and when carefully made will respond to the following test:

The mirror "D" has 3 small magnets, "G", made from a magnetized watch spring, glued to its back.



End and Sectional View of Reflecting Mirror Galvanometer. One of the Most Sensitive Instruments of the Kind Available. Invaluable for Measuring Extremely Weak Currents.

Take a sewing needle and an ordinary pin and connect them to the instrument. Immerse both needles into a drop of salt water and the galvanometer will indicate a current generated by this tiny battery of two needles and a drop of salt water.

In Fig. 1 "A" is a wooden bobbin turned to the dimensions shown and with a ½-inch diameter hole in the center. One side is then cut flat as shown to permit screwing it to the baseboard "B".

"C" is a short glass tube ⅛-inch diameter by ⅝-inch long, and is inserted in "A".

The bobbin "A" is wound with enameled wire about No. 36 or No. 38 B. & S. gauge, and the ends of the wire are connected to the binding posts "K".

"H" is a pin which serves to adjust the silk thread "F".

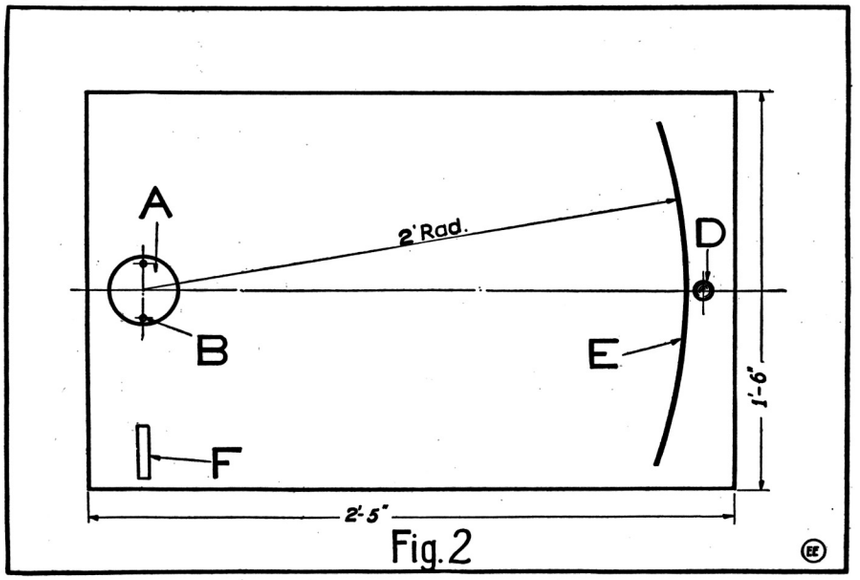
"I" is a sheet of thin black fibre to protect the enameled wire.

In building this instrument care must be taken to use brass screws only, as steel screws would affect its efficiency.

Figure 2 shows the galvanometer with its accessories.

"A" is the galvanometer with its binding posts "B". "C" is the baseboard 2 feet 5 inches long by 1 foot 6 inches wide.

"D" is a small electric lamp that throws its light upon the mirror of the galvanometer from where it is reflected to the scale "E" which is made from a brass strip about 1 foot 3 inches long bent to the arc shown. On this brass arc there is pasted a strip of drawing paper graduated in half inches or finer.



Plan View of Galvanometer with Zero Control Magnet F, Source of Light D and Graduated Scale E. Sometimes a Small Telescope is Placed Just Above D Thru Which to Observe the Moving Mirror and Scale Image

"D" is a small silvered mirror about 5/16-inch diameter, suspended from a bent brass wire "E" by means of a silk thread "F".

The lamp "D" must be above the scale and covered with a tube having only a small hole, say ⅛-inch diameter, on one side so that a narrow beam of light is reflected to the scale "E" by the mirror.

"F" is a small steel magnet to steady the mirror magnets. The best distance from "F" to the galvanometer must be found by experiment. It should be just close enough to exercise control over the moving element. If too close it will lower the sensitivity of the galvanometer. An oil lamp may be used instead of the electric bulb "D".

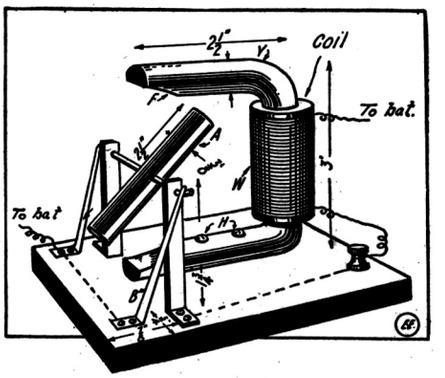
Every experimenter should own a sensitive galvanometer such as the one here described. The higher the resistance, the greater the sensibility of the instrument. *Shunts* may be placed across the terminals for strong currents.

A BATTERY MOTOR OF FEW PARTS.

The constructional details of a cheap and simple battery motor are shown in the drawing here. The material needed is listed below.

8" ⅜" soft iron rod
2½" ⅜" soft iron rod.
2 pieces brass 2½"x¼"x⅛"
8 small wood screws
2, ¾", 6-32 bolts
Base board 4"x4"x½"
2 pieces brass spring 2¼"x¼"
1 piece steel wire 3"xNo. 12
25 feet No. 20 S. C. C. magnet wire.

The longer piece of iron rod is bent as shown at Y, Fig. 1. The points F, F are filed away to present a larger pole face to the ends of the armature A, thus increasing the strength of the motor. One of the legs is filed down about ⅛" and two small holes H, H are drilled, through which ¾" machine screws are placed, which secure it to the base. This field member is mounted on the base centrally. The smaller piece



Battery Motor of Few Parts. Iron Parts of Soft Annealed Stock and Only One Magnetizing Coil Required

has a hole bored through the center of it, through which the piece of No. 12 wire is passed, the rod being soldered to it at the center. The details of the bearings and brushes are given in the drawing. The shaft is bent to make contact when armature is 180° around and to break when 360° around. The two shaft ends are bent in opposite directions, so that there are two contacts during each revolution. The armature must run true and easily and clear magnet at F, by about 1/16". The wire is wound on at W. For convenience the yoke Y may be taken from base. If not, it must be adjusted by placing small pieces of wood under magnet or bearings.

One end of the coil is fastened to binding post, the other to bearing. The two brushes are connected together. This motor is designed to run on eight cells, four in series and two in multiple. With this power and with a pulley and flywheel on the shaft the motor may be used for driving small mechanical toys. The motor will run light on two cells.

Contributed by WALTER D. SHOLL.

Experimental Chemistry

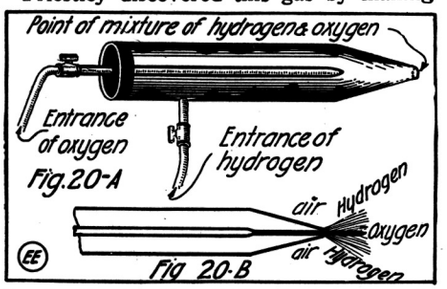
By Albert W. Wilsdon

Fifth Lesson

OXYGEN.

OXYGEN is a colorless, odorless, and tasteless gas. It is the most widely distributed element. It was discovered on August 1st, 1774, by Joseph Priestley, and a few weeks later, Scheele, a Swedish apothecary, published his method of preparing this gas.

Priestley discovered this gas by making



Showing Construction of the Compound Nozzle of the Oxy-Hydrogen Blow Pipe, also How the Gases Combine in the Flame.

Mercuric Oxide (HgO) and, owing to the lack of burners having high temperatures, he had to obtain the required heat to break up this compound by using a large burning glass and focusing the sun's rays on the Mercuric Oxide. He collected the gas under water, in much the same manner as we do now. Priestley called the gas (which is now called Oxygen) *Dephlogisticated Air,* which name is now obsolete.

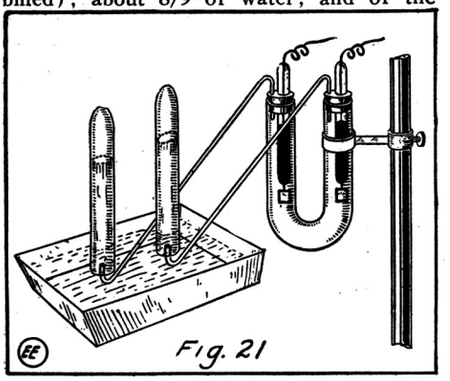
Karl Wilhelm Scheele, a Swedish apothecary, also discovered this gas by a different method than Priestley. Scheele heated Potassium Chlorate ($KClO_3$) and collected the gas in a bladder. He termed this gas *Empyreal Air.*

Shortly after Scheele published his discovery, Condorcet suggested that both Dephlogisticated Air and Empyreal Air be changed to *Vital Air.*

In 1789, Antoine Laurent Lavoisier, a famous French chemist, after a series of carefully conducted and very ingenious experiments, found that the increase in weight of iron, which he burned in oxygen, among his experiments, equaled the weight of the oxygen taken up. By this he proved that the combustion of bodies in air consisted essentially in their combination with *Oxygen* the name which it now retains.

Occurrence and Distribution:

Oxygen is the most widely distributed and most abundant of all the elements. In its free state it constitutes about 1/5 of the atmosphere (here it is mixed, and not combined); about 8/9 of water; and of the



The Water Decomposition Apparatus Complete, Including Catch Tubes.

earth's crust (rocks, limestone, marble, clay, quartz and sand, etc.) about half. It is also contained more or less abundantly in almost all organic compounds, except hydrocarbons, and in every part of animals and plants; and is also found to be a constituent of most acids, bases and salts.

Relation to Life:

Oxygen is essential to all forms of respiration, both in animals and plants. As shown by experiments with mice, etc., if they are deprived of air, they die.

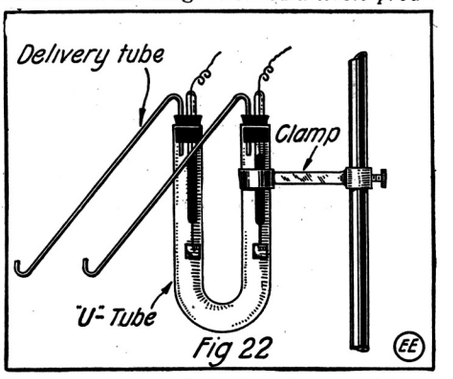
When air (of which oxygen is the chief ingredient) is drawn into the lungs, it gives up a large proportion of its oxygen to the blood which absorbs it readily, and is then carried to all parts of the body by this agent. The numerous tissues are slowly oxidized, during which process heat is liberated, and waste products, the chief one being Carbon Dioxide (CO_2), which is carried by the blood to the lungs and there exhaled.

Let us now perform an experiment whereby we can show the relative amount of Carbon Dioxide which is contained in the lungs..

EXPERIMENT NO. 15.—Take a small beaker or test tube and partially fill it with limewater. Next take a piece of glass tubing and blow your breath into it, causing bubbles to form in the limewater.

You will notice that a curdy white precipitate forms which gradually increases. This is one method of determining the presence of *Carbon Dioxide.*

Because this carbon dioxide which is exhaled from the lungs is called a *waste product* the reader might assume that this gas has no properties which will benefit anything. This is not so. As we thrive on oxygen so plants thrive on carbon dioxide, which they absorb from the air through their leaves. The plants retain the carbon of this compound (CO_2) in their tissues, much the same as we retain the oxygen of the air in our body, but plants return a large quantity of the oxygen to the atmosphere. (Plants also inhale a very small quantity of oxygen directly from the air, and exhale it as Carbon Dioxide.)



The Electrolysis Cell is Best Supported by a Clamp on a Laboratory Stand as Shown.

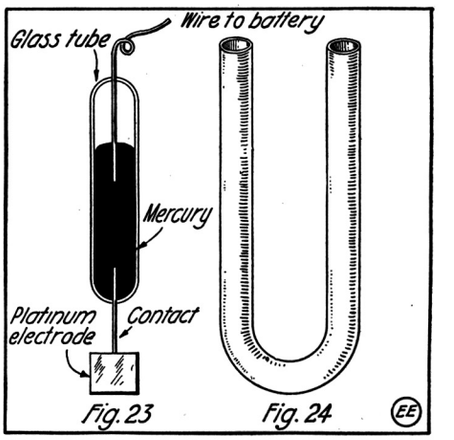
It can be readily seen from the foregoing that plants and animals co-operate in maintaining a quantity of oxygen in the air that is constant.

Many people believe that fishes live without any air whatsoever, because when taken from the water and left in the air for any period of time they die. While fishes do not always obtain *air,* they do obtain the desired oxygen necessary to support life from the dissolved oxygen which the water absorbs from the atmosphere.

PREPARATION:—Oxygen is prepared by various processes. Below are a few of the most important ones:

1. In the laboratory this gas is prepared by heating Potassium Chlorate ($KClO_3$) and Manganese Dioxide (MnO_2) in a closed tube, and collecting the gas by the displacement of water in a receiver, under water.

2. THE BRIN PROCESS:—This consists of forcing pure air, by means of a



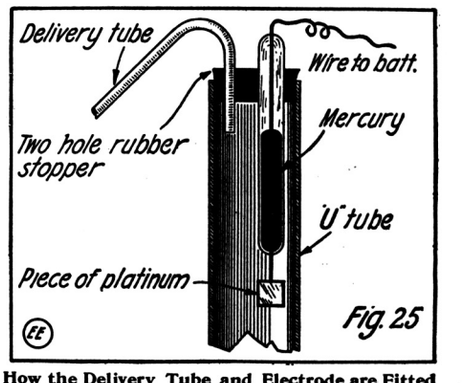
One of Glass Mounted Electrodes and Glass "U" Tube Making Up Electrolysis Cell Used to Decompose Water

pump, over Barium Oxide (BaO) which has been heated to about 700 degrees Centigrade or 1292 degrees Fahrenheit, thereby forming the higher oxide, Barium Dioxide (BaO_2). The air supply is then cut off and the pressure reduced by reversing the pump. By this operation the Barium Dioxide is converted into Barium Oxide and Oxygen. The gas is collected in a reservoir and the process repeated.

3. By the ELECTROLYSIS OF WATER which consists in putting water in the U tube of the apparatus shown by Fig. No. 21 and collecting the oxygen from the anode (or positive electrode). The hydrogen is liberated from the cathode (or negative electrode), and may be collected in the same manner as the oxygen. During the electrolysis of water, twice as much Hydrogen is set free as oxygen.

(It is advisable to introduce a small quantity of Sulphuric Acid (H_2SO_4) into the water to form a better conductor of the electric current. Before adding the Sulphuric Acid to the water carefully read and follow the directions given in the June, 1916, issue of THE ELECTRICAL EXPERIMENTER, under *Laboratory Operations.*)

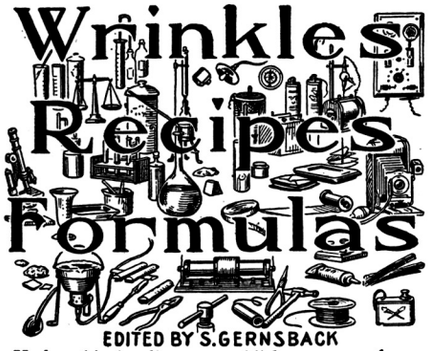
4. Oxygen is prepared in large quantities from LIQUID AIR, the constituents of which are Oxygen and Nitrogen. The prin-



How the Delivery Tube and Electrode are Fitted Thru a Rubber Cork in Top of "U" Tube Chamber of Electrolysis Cell.

ciple of the preparations of Oxygen from Liquid Air lies in the fact that both Oxygen and Nitrogen when in the liquid state,

(*Continued on page 460*)



EDITED BY S. GERNSBACK

Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 26.
Polishes—15 Kinds.

Carvers' Polish.—White resin, 2 ozs.; seedlac, 2 ozs.; spirits of wine, 1 pt. Dissolve. It should be laid on warm. Avoid moisture and dampness when used.

French Polish.—Gum shellac, 1 oz.; gum arabic, ¼ oz.; gum copal, ¼ oz. Powder and sift through a piece of muslin; put them in a closely corked bottle with 1 pt. spirits of wine, in a very warm situation, shaking every day till the gums are dissolved; then strain through muslin, and cork for use.

Polish for Dark Colored Woods.—Seedlac, 1 oz.; gum guaiacum, 2 drs.; dragon's blood, 2 drs.; gum mastic, 2 drs.; put in a bottle with 1 pt. spirits of wine, cork close, expose to a moderate heat till the gums are dissolved; strain into a bottle for use, with ¼ gill of linseed oil; shake together.

Waterproof Polish.—Gum benjamin, 2 ozs.; gum sandarac, ¾ oz.; gum anima, ¼ oz.; spirits of wine, 1 pt.; mix in a closely stopped bottle, and place either in a sand bath or in hot water till the gums are dissolved, then strain off the mixture, shake it up with ¼ gill of the best clear poppy oil, and put it by for use.

Finishing Polish.—Gum shellac, 2 drs.; gum benjamin, 2 drs.; put into ½ pt. best rectified spirits of wine in a bottle closely corked; keep in warm place, shaking frequently till the gums are dissolved. When cold, shake up with it two teaspoonfuls of the best clear poppy oil.

Polish for Removing Stains, Spots and Mildew from Furniture.—Take of 98 per cent. alcohol, ½ pint; pulverized resin and gum shellac, of each, ¼ oz. Let these cut in the alcohol; then add linseed oil, ½ pt.; shake well, and apply with a sponge, brush, or cotton flannel, or an old newspaper, rubbing it well after the application, which gives a nice polish.

Polish for Reviving Old Furniture.—Take alcohol, 1½ ozs.; spirits of salts (muriatic acid), ½ oz.; linseed oil, 8 ozs.; best vinegar, ½ pt.; and butter of antimony, 1½ oz.; putting in the vinegar last.

Jet or Polish for Wood or Leather, Black, Red, or Blue.—Alcohol (98 per cent.) 1 pt.; sealing wax, the color desired, 3 sticks; dissolve by heat, and have it warm when applied. A sponge is the best to apply it with.

Polish for Turners' Work.—Dissolve sandarac, 1 oz., in spirit of wine, ½ pt.; next shave beeswax, 1 oz.; and dissolve it in a sufficient quantity of spirits of turpentine to make it into a paste, add the former mixture by degrees to it, then with a woolen cloth apply it to the work while it is in motion in the lathe, and with a soft linen rag polish it. It will appear as if highly varnished.

Furniture Polish.—Beeswax, ½ lb., and ¼ of an oz. of alkanet root; melt together in a pipkin until the former is well colored. Then add linseed oil and spirits of turpentine, of each half a gill; strain through a piece of coarse muslin.

French Polishes.—1. Shellac, 3 lbs.; wood naphtha, 3 pts., dissolve. 2. Shellac, 2 lbs.; powdered mastic and sandarac, of each 1 oz.; copal varnish, ½ pint; spirits of wine, 1 gal. Digest in the cold till dissolved.

Black Walnut Polish.—Take pulverized asphaltum; put in a jar or bottle, pour over it about twice its bulk of turpentine or benzole, put in a warm place, and shake occasionally; when dissolved, strain and apply it to the wood with a cloth or stiff brush; should it prove too dark, dilute with turpentine or benzole. If desired to bring out the grain still more, apply a mixture of boiled oil and turpentine; this is better than oil alone. When the oil is dry the wood can be polished with the following: shellac varnish, 2 parts; boiled oil, 1 part; shake it well before using. Apply with a cloth, rubbing briskly.

To Polish Wood.—Take a piece of pumice-stone and water, and pass repeatedly over the work until the rising of the grain is cut down. Then take powdered tripoli and boiled linseed oil, and polish the work to a bright surface.

Clock Case and Picture Frame Finish.—Copal varnish, 2 lbs.; linseed oil varnish, ½ oz.; mix well, shake often, and place in a warm spot. The wood to be varnished is prepared with a thin coat of glue-water, and rubbed down with fine pumice-stone or something equivalent. In light-colored wood, a light pigment, such as chalk, is added to the glue-water; in dark wood, a dark pigment is added. When ready, the articles are varnished with the above mixture, and, after drying, rubbed with a solution of wax in ether, thereby receiving a high polish.

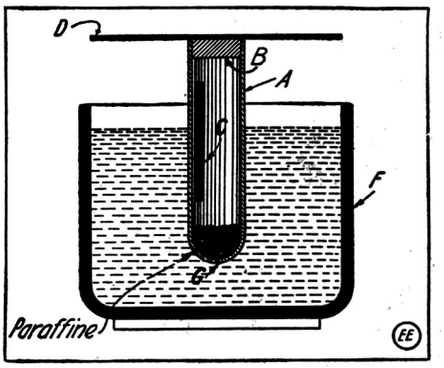
White Polish for White Woods.—White bleached shellac, 3 ozs.; white gum benzoin, 1 oz.; gum sandarac, ½ oz.; spirits of wine or naphtha, 1 pt. Dissolve. S. G.

AN ACID THAT SETS FIRE TO PAPER.

Perchloric acid is one of the most energetic oxidising agents known. The concentrated acid contains 63.68 per cent. of oxygen, with a portion of which it parts most readily in contact with combustible materials. If a drop of the acid is allowed to fall upon a piece of paper, the latter is ignited. It explodes with charcoal, and also, but more violently, with ether. In appearance perchloric acid resembles sulphuric acid, being a colorless oily fluid, 1.78 times as heavy as water.

A SIMPLE WEIGHING BALANCE.

A fairly sensitive scale can be made in a few minutes as follows: Take a test-tube A of about 1 inch diameter by 8 inches long, and put into it some melted paraffine G so that the tube floats upright in water. Fit a cork stopper B into A and glue to B a round tin or brass disc D of about 4 inches diameter. Put the tube A in a glass F containing water. Next put known weights, say ¼, ½ and 1 ounce, on D and mark the waterlevel for these different points on the tube. Prepare a strip of drawing paper and graduate it to suit these marks of ¼, ½ and 1 ounce. Paste this paper scale inside the tube A, taking care to get it in the right place, and the balance is completed. A balance of this type has



Small Weighing Balance Made from Test-tube and Vessel Containing Liquid.

no parts to get out of order and will serve very well for weighing photographic chemicals, etc.

Contributed by C. A. OLDROYD.

MAKING A CRYSTAL BASKET.

Water will, especially when boiling, dissolve large quantities of various substances, which, when the water has cooled, are left behind in the form of most beautiful crystals, the shapes of which may vary with the substance employed. One may take advantage of this fact to make very handsome ornaments. It is also known that boiling water will take up a much larger quantity of alum than cold water. If we dissolve as much alum as possible in the former, as the liquid cools, crystals of alum will be deposited on any object placed in the fluid. A piece of coke or cinder allowed to stand in a boiling solution of alum, will become coated with numerous glistening crystals as the liquid cools. It will have the appearance of a naturally formed mineralogical specimen.

Ornamental baskets, etc., may be formed in this way by covering wire or willow baskets. The baskets covered with wire and then cotton are the most successful as the surface to be coated with crystals must be somewhat rough. Take twice as much water as will be sufficient to cover the basket, boil it in a saucepan and add as much alum as will dissolve in the water. A quart of water will require about 18 ounces of alum. Strain this through muslin or blotting paper into a large jar and hang the basket in the boiling liquid. Stand the jar on one side to cool and keep free from dust. In a few hours the basket will be completely covered with white crystals of alum. Should it be desired to color the crystals, add the requisite dye-stuff to the alum solution before straining it. A few drops of cheap dyes will serve the purpose well.

Contributed by H. G. FRANK

SILICA FILLING CEMENT.

Pour one gill of *Silicate of Soda* or *Potash* in a large tumbler (the *Silicate of Soda* or *Potash* is commercially known as *Soluble Glass* and can be bought at any wholesale druggist).

Now add one gill of *Water* to the *Soluble Glass* and mix the two liquids with a wooden stick. In another glass tumbler pour another gill of *Water*, to which is added one gill of *Hydrochloric Acid* (called also *Muriatic Acid*).

Now slowly pour the *Muriatic Acid* and *Water* into the tumbler containing the soluble glass solution and gelatinous silica, which will be thrown to the bottom of the glass, pour off the excess liquid left in the glass. Wash the gelatinous silica in a little water, allow to dry. When dry the silica will be in the form of powder. This powder is pure silica.

Mix the pure silica with soluble glass to which no water has been added, until it forms a creamy paste. Apply quickly. This forms a very hard cement, suitable for repairing and filling in holes, cracks, seams in marble, stone and wood, also glass and almost any place where a hard stone-like cement is needed.

Contributed by MAURICE BERGER.

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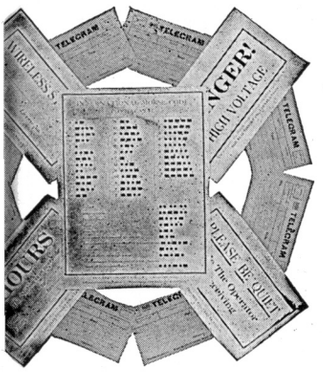

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Vandergrift, Pa.
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WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

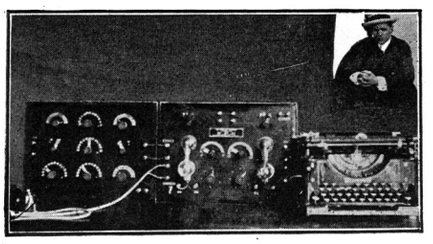
EXCELLENT RADIO STATION OF MINOR M. FARLEIGH.

As the photo shows, I constructed two cabinets to make my radio instruments as attractive as possible and still have binding posts to carry on various experiments or be able to place one cabinet on top of the other, without unsightly external connections.

In the cabinet at the left is a complete tuning apparatus, consisting of large loose coupler with necessary taps, loading coil, primary and secondary condensers, together with switches for cutting them in and out.

The cabinet at the right has the Audion detector and amplifier, with necessary batteries and 1 to 1 ratio transformer. In the lower left-hand corner of this cabinet there is a small switch to change for spark or arc transmitters. A variable pencil-mark static reducer is used successfully on the amplifier grid and wing terminals, when necessary. A permanent magnet is used on the detector bulb, which brings in distant stations otherwise inaudible.

This set has given very good results during the past winter in New York City under very unfavorable conditions. The four wire antenna, 90 feet long and 80 feet high was shut off completely to the south and west by towering steel buildings; yet on



Radio Receiving Set of Prize Winner M. M. Farleigh, with Which He Has Picked Up Messages from All Over the United States.

clear nights, steamers working off Florida could be heard distinctly, and most of the Naval and commercial stations along the Atlantic coast from Portsmouth NAC down to Miami.

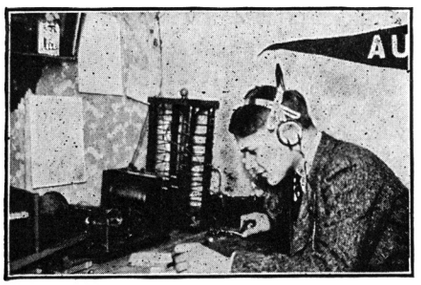
Countless Amateurs have been heard, including a few in the middle west; NAA and WST come in quite clearly, using a gas-pipe line in the house for an aerial.

I attribute a great deal of the results under these unfavorable conditions to a good ground obtained by running a 75 foot No. 4 stranded copper wire direct to a water pipe near the ground in the cellar. Experiments proved this ground to be far superior to a connection made to water pipes on the fifth floor, where the instruments were located.

I am now using this set for the summer on Long Island and with a 60 foot aerial, 30 feet high, have heard Key West two feet from the head 'phones during the warmest nights of late June.

WIRELESS STATION OF HOWARD YOUNG.

My radio receiving set consists of a loose coupler and loading coil, each rated at 2,000 meters, also variable and fixed



Mr. Howard Young busy at His Radio Set. His Call Is 8AW.

condensers. I have a double detector, silicon and galena, and can employ either by throwing a switch. My 'phones are Brande's superior type.

In my sending outfit I utilize a one-inch spark coil operated by a 12-volt storage battery. By means of this I can talk with other amateurs 5 miles distant. My aerial is 200 feet long and 50 feet high, composed of four strands and spaced 2½ feet apart.

I obtain good results from my set as I hear NAA quite loud at noon and can hear some stations with the 'phone held several inches away from my ears. I have been working with wireless for about a year. My call is 8 AW.

HOWARD YOUNG.

Camp Chase, Ohio.

I thank all the amateurs whose descriptions I have studied in the monthly contest, for from their ideas, I was able to construct my own set.

MINOR M. FARLEIGH.

New York City, N.Y.

NEW SPERRY WIRELESS UNIT FOR AEROS.

Uncle Sam has succeeded in outstripping other nations in at least one branch of army service—that of wireless instruments for aeroplane reconnaissance. Compressed into a little package that an aviator might almost stick into his pocket is a new wireless instrument capable of carrying messages for sixteen miles, and weighing only seven pounds.

The device is the invention of Elmer A. and Lawrence B. Sperry of gyroscope fame. According to Henry A. Woodhouse, member of the board of governors of the Aero Club of America and director of the American Society of Aeronautic Engineers, the miniature wireless will revolutionize the use of such instruments and will give the nation which controls its use a marked advantage.

"Heretofore, radio sets have weighed from two to four pounds for every mile radius," said Mr. Woodhouse. "It always has been thought that an ideal set would be one that would weigh one pound for each mile radius. This instrument, as it has been shown, has far outstripped even the hopes of other inventors, and the most hopeful part of the discovery is the fact that its radius may be increased with but a slight proportionate increase in weight."

RAYMOND SMITH'S RADIO STATION.

The transmitting apparatus in my station consists of the following: A ½ K. W. Electro Importing Company's transformer; plate glass condenser, stationary spark gap and a helix converted into an oscillation transformer, and an electrolytic interrupter to interrupt the primary circuit and a transmitting key with extra large contacts.

On the receiving side I use the following with very good success: A 3,000 meter loose coupler, De Forest Audion, variable condenser in parallel with the secondary of the receiving transformer and Murdock 2,000 ohm 'phones.

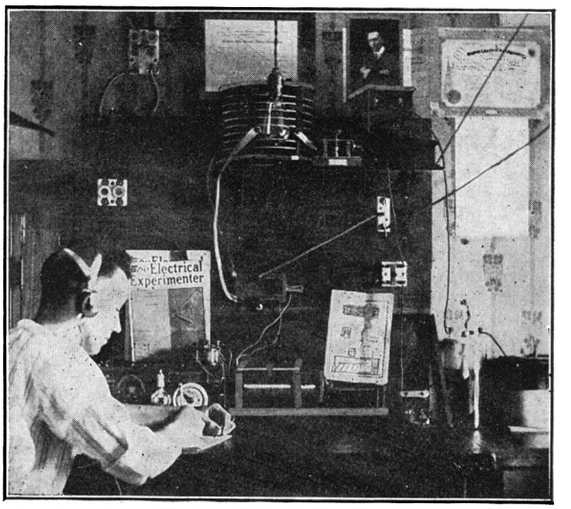
I have one wire aerial 500 feet long for receiving long wave stations and a three wire aerial 70 feet long and 40 feet high for transmitting and receiving from amateur stations.

With this outfit a daylight receiving range of 1,500 miles is attained, while the Amateurs from every part of the state are tuned in with ease.

My transmitting set has successfully covered a distance of 16 miles. I am at present working on an undamped wave receiving set, and when this is finished a photo and description will be sent to THE ELECTRICAL EXPERIMENTER.

I am a member of The Radio League of America and the Central Radio Association, also hold a second grade government license with an official call of 8 KL.

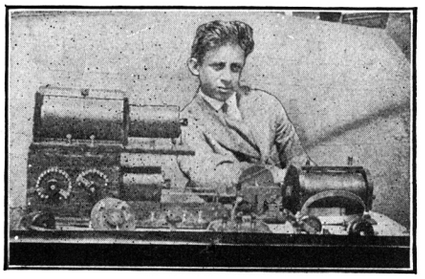
Tippecanoe City, O. RAYMOND SMITH.



The Complete Wireless Set of Mr. Raymond Smith, of Tippecanoe City, Ohio. Call 8KL.

WIRELESS EQUIPMENT OF H. A. DePALMA.

Among my radio receiving apparatus there are two loose couplers, one of the Navy type, which is controlled by



Excellent Radio Outfit of H. A. DePalma. He Holds a Membership in the Radio League of America.

switches and has a range of 4,500 meters. The other one I use for shorter wave lengths, but each of them can tune in NAW very accurately, as well as NAA. I also use a Clapp-Eastham variable condenser, a pair of Brandes' 1,000 ohm 'phones, one Holtzer-Cabot 'phone, and Electro Importing Company's fixed receiving condenser, also a Murdock silicon detector, which works very efficiently.

The sending set comprises a one-inch coil and a rotary spark gap, which produces a pure, musical pitched note. A serviceable silver contact key is used with a shunt condenser. The D.P.D.T. switch can be thrown to either side with ease. I have a very large aerial of the umbrella type, occupying the roofs of a whole city block, the wires extending in every direction in very long lengths.

I would also like to mention the fact that I cannot do without THE ELECTRICAL EXPERIMENTER magazine, as it is the greatest help in my researches and experiments. I am also a member of The Radio League of America.

H. A. de PALMA.

New York City, N.Y.

WIRELESS OPERATORS WANTED BY THE NAVY.

The Navy wants wireless operators who will volunteer their service in case an emergency should arise. This is the word given out by Sam Schnelle, navy recruiting officer at Evansville, Ind. He has received instructions from the New York headquarters to secure the consent of any amateur wireless operators to offer their services in case of war. The applicant is required to give his services only in time of need, and his name will be placed on the honor roll of the country.

UNDERGROUND PHONE NOW.

Dr. H. Barringer Cox announces that he has perfected a subterranean wireless telephone and incidentally discovered a new law of physics—that electrical energy can be transmitted over a single conductor.

For the last five months Dr. Cox has been working at Los Olives, Cal., with the United States forest service experts in an effort to perfect a system of wireless signals for forest fires.

It was while so engaged that he discovered the possibilities of transmitting the human voice through the ground.

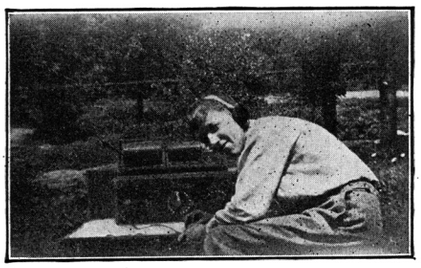
His equipment consists of an ordinary telephone transmitter connected with a battery and a special instrument—Dr. Cox's secret—with a ground wire. At the receiving station, five or fifty miles away, is a similar equipment.

LONG DISTANCE TELEPHONE TO HAVANA.

On the completion of the long distance line to Key West, Fla., by the American Telephone and Telegraph Company, steps will be taken to lay a submarine cable between that point and Havana, Cuba.

MR. W. DENNIS A WIRELESS ENTHUSIAST.

In the illustration one may perceive a 4,000 meter loose coupler, located on top of the cabinet and a 21 point loading coil, a fixed variable condenser, with six points. The "buzzer test" is controlled by a flush type push button, located in the right-hand corner. The cat-whisker detector is on the left-hand side. This set, with the exception



Mr. W. Dennis and His 4000 Meter Radio Receiving Set.

of loose coupler and 1,000 ohm receiver, is all home-made.

W. DENNIS.

Des Moines, Iowa.

Amateur News

Germantown Radio Association Now the Philadelphia Radio Association.

This association was formed three years ago with five members, and at the present time has about 150 members on its roll. The association holds its meetings at 5801 Germantown Ave., on the third Monday of each month. Its members have the use of the club library; a wave meter, which was calibrated by the Bureau of Standards of Washington, D. C., a large dance floor, and an up-to-date piano in the club room, which is about 100 x 45 feet.

There is an aerial over the building which is used for demonstrating various apparatus. The club also offers good speakers, and among those who have spoken are Mr. A. B. Cole, of New York; Prof. L. Knoll, of Central High School, Philadelphia; Mr. Chas. Ballantine of N. E. M. T. S., Philadelphia; Mr. E. E. Hubbs, Philadelphia; Mr. S. S. Harris, Philadelphia; Mr. F. B. Chambers, Philadelphia; Mr. Paul B. Huyette, Philadelphia; Mr. Charles Stewart, St. Davies, Pa., and several others of note. The association dues are $1.00 per year; each member receiving a card identifying him with the club.

The officers are as follows: President, W. F. Wunder; Vice-President, E. E. Hubbs; Treasurer, J. Hamilton; Recording Secretary, C. Ballantine; Corresponding Secretary, S. S. Harris. Entertainment Committee—Paul B. Huyette; Pin Committee (three members), Membership Committee (four members), Technical Committee (four members); Research Committee (four members), Press Committee (three members), Legislative Committee —Charles Stewart.

The business of the association is carried on by a board of directors consisting of seventeen members and the president. The club prints a club paper known as *The Oscillator*. The officers invite correspondence and attendance at the club meetings.

The Mountain States Radio Association.

A radio club, under the name of "The Mountain States Radio Association," has been organized at Denver, Colo., for the purpose of promoting radio communication among the amateurs of the Rocky Mountain region. Two meetings have been held and the following officers elected: President, D. L. Clark; Vice-President, R. S. Whitaker; Secretary, C. F. Neumann; Treasurer, A. J. Winterer; Chief Operators, E. R. La Duke.

The club consists entirely of licensed members, this being one of the requirements of admission.

A "time" sending service has been inaugurated and the time, as received by the chief operator from Arlington, is sent out nightly at nine o'clock, on a two hundred-meter wave-length.

Communications from other clubs are invited and should be sent to the secretary at 1523 South Ogden St., Denver, Colo.

Boy Scouts of Sch. Haven, Pa., Radio Enthusiasts.

The Boy Scouts of this city have organized a wireless and research committee and the following members have been chosen: Carl S. Dress, John H. Baker, William Stauffer, Donald Eiler and Charles Kaufman.

Carl Dress, John Baker and Donald Eiler are the wireless operators. The whole organization will in the near future have a fine laboratory.

Address all communications to Carl S. Dress, 22 to 24 E. William St., Sch. Haven, Pa.

The Rhode Island Radio League.

The Rhode Island Radio League was organized for grouping the various amateurs in Rhode Island. At a recent meeting, held by the officers of the league, "calls" were assigned to the members who were not already supplied with Government calls. The idea of this assignment is to facilitate the calling of each club member. On Dec. 5 the following officers were elected for a term of one year: Ralph J. Liedel, president and treasurer; James G. Sacs, secretary; Bernard Riley, station inspector.

The station inspector is a newly created office. He inspects the stations of the members and advises them what would be the best way to arrange their sets, etc. In other words, he is a source of general information for the club members.

All communications to the club should be addressed to the secretary, Jas. G. Sacs, 124 Prairie Ave., Providence, R. I., or call A-1-1 or A-1-2 "via wireless."

Formation of the New Rochelle Radio League.

The amateur wireless workers of New Rochelle, N.Y., met on February 3, 1916, and formed a radio club for the advancement and betterment of wireless in this city. The club is to be known as The Radio Club of New Rochelle, N.Y.

The club was formed on a substantial basis, he initial membership being twenty. The following officers were elected: President, John Bucknam; vice-president, Etienne Donovan; secretary and treasurer, Thomas Havard; press agent, Edward Bettels. Under these competent executive officers, the club is expected to flourish.

A library with books pertaining to electricity and wireless is an important consideration. A committee was appointed to handle this work. An electrical committee was also appointed to supervise the experiments and take charge of the large station installed by the club.

Other clubs are invited to correspond with the secretary, Thomas Havard, 48 John Street, New Rochelle, N.Y.

RADIO EXPERIMENTER'S ASSOC. OF THE STATE N. Y.

A radio experimenters' association bearing the above name has been organized and the following officers elected: President, Walter L. Miller; Vice-president, Marion Cimma; Secretary and Treasurer, Manager of the operating staff and Librarian, M. Kestenbaum.

Before the meeting adjourned it was unanimously voted that all members join the Radio League of America.

The object of the association is the furtherance of knowledge in the science of Wireless Telegraphy and Telephony among the amateurs to bring them into closer relationship and to mutually help all those interested. Write to the Secretary, 510 W. One Hundred and Forty-seventh St., New York, N.Y. Prospective members should write to the President, Walter L. Miller, 96 Pitt St., New York, N.Y.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the month of March, 1916. (Continued.)

SECOND DISTRICT—(Cont'd).

Call signal	Owner of station.	Location of station.	Power kilowatts.
2AMK	Allin, Willis F.	1148 Fairmont Ave., Elizabeth,N.J.	.5
2ALV	Atkinson, Benjamin	496 Park Ave., Paterson, N. J.	.5
2AMR	Avery, John	4 Spruce St., Corona, N. Y.	.5
2AMH	Bettels, Edward T.	56 Rockdale Ave., New Rochelle, N. Y.	.5
2ALW	Benson, Warren S.	4 Fuller Pl., New York, N. Y.	.5
2ANT	Brown, Mortimer	Sayville, N. Y.	.5
2AMI	Brush, Geo. S., Jr.	326 E. Main St., Patchogue, N. Y. (In partnership with Howard Van Cleaf.)	.5
2AMW	Coon, George	36 116th St., New York, N. Y.	.5
2ANQ	Crowe, Howard A.	Harrison, N. Y.	.5
2KI	Eaton, Donald	1533 St. Nicholas Ave., New York, N. Y.	1
2ALE	Fingerlin, Harold J.	296 Washington Ave., Rockaway Beach, N. Y.	.5
2ANF	Fish, Edward H.	27 Highland Ave., Middletown, N. Y.	.5
2ANM	Foot, N. Brainard	1432 75th St., Brooklyn, N Y.	.5
2AME	Frank, Richard	408 Main St., Union, N. J.	.5
2AMY	Geils, Henry	1 Walton Ave., New York, N. Y.	.5
2ANC	Guy, Raymond F.	342 Broadway, Tottenville, N. Y.	1
2AMN	Hart, Phillip	225 Brighton Ave., Perth Amboy, N. J.	.5
2ANI	Heinzmann, Milton	991 Chancellor Ave., Irvington, N. J.	.5
2AMO	Heiss, Walter	51 Crawford St., Newark, N. J.	.5
2ANV	Hirschfield, Edward	338 W. 18th St., New York, N. Y.	.5
2ALX	Hobson, Christopher E.	1018 Columbus Ave., Westfield, N.J.	1
2ANJ	Hoff, Russell S.	298 Western Ave., Albany, N. Y.	.5
2ALO	Huff, Frederick W.	665 State St., Perth Amboy, N. J.	.5
2ALP	Hulse, Tremaine	32 3d Ave., Bayshore, N. Y.	.5
2AMS	Hunter, John W.	68th St., and 2d Ave., Brooklyn, N. Y.	.5
2AMG	Jaques, Channing K.	150 Elm St., New Rochelle, N. Y.	.5
2ALR	Kells, David G.	253 73d St., Brooklyn, N. Y.	.5
2ANG	Kirschoff, Willard J.	438 E. 148th St., New York, N. Y.	.5
2AND	Klune, Fred C., Jr.	Harrison, N. Y.	.5
2ANS	Koyen, Walter R.	Woodbridge, N. J.	.5
2ANB	Leo, Nelson	600 W. 183d St., New York, N. Y.	.5
2ANA	Lindheimer, Carl M.	102 Watson Ave., Newark, N. J.	1
2ALN	Mason, Percy H.	106 Lewis St., Paterson, N. J.	.5
2ANE	McLean, True	38 Central Ave., Tomkinsville,N.Y.	1
2ANU	Midgley, Herbert	59 Brewster St., Tompkinsville, N. Y.	.5
2AML	Mueller, Carl F., Jr.	440 Monroe Ave., Elizabeth, N. J.	1
2ALQ	Mulvaney, Thomas	1903 Barnes Ave.,Westchester, N.Y.	.5
2ANO	Nelson, Irving J.	80 E. 115th St., New York, N. Y.	.5
2ALS	Oetjen, John J.	543 17th St., West New York, N. J.	.5
2ALU	Peiler, Harold L.	321 E. 90th St., New York, N. Y.	.5
2ANH	Raufer, Frank J.	50 Shepherd Ave., Brooklyn, N. Y.	.5
2AMJ	Ruddy, Geo. F.	186 High St., Perth Amboy, N. J.	.5
2AMZ	Roehrich, Henry	2 Belmont Ave., Garfield, N. J.	.5
2ANN	Roquer, Leon E.	76 Fox Ter., Dunwoodie, N. Y.	.5
2ANW	Schaefer Maximillian	73 W. 115th St., New York, N. Y.	.5
2AMC	Seiler, Frank B.	54 Elm St., Summit, N. J.	.5
2ANK	Seitz, Wesley	7 Seitz Court, Patchogue, N. Y.	.5
2ANX	Shaw, Albert E., Jr.	1060 72d St., Brooklyn, N. Y.	.5
2ALM	Sheldon, Henry B.	26 Main St., Keyport, N. J.	.5
2AMF	Smith, Wm. W.	207 Wegman Parkway, Jersey City, N. J.	.5
2AMU	Tennon, Evans, H.	705 1st Ave., Asbury Park, N. J.	.5
2ANP	Valentine, Russell D.	165 Amboy Ave., Woodbridge, N.J.	.5
2AMI	Van Cleaf, Howard	326 E. Main St., Patchogue, N. Y.	.5
2AMB	Van Dyke, Theo. F., Jr.	246 Morris Ave., Summit, N. J.	.5
2ALT	Van Loan, Harold H.	Athens, N. Y.	.5
2AMT	Voipel, Daniel, Jr.	1162 Forest Ave., New York, N. Y.	.5
2AMP	Von Ardyn, John	125 Riverside Drive,New York,N.Y.	.5
2AMQ	Von Frankendorff, L.	403 S. 7th St., Newark, N. J.	.5
2ANR	Walcutt, Frank	841 W. 179th St., New York, N. Y.	.5
2AMD	Weatherbee, W. T.	Millington, N. J.	.5
2AMX	Whittleton, Harry M.	Palisades Park, N. J.	.5

THIRD DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
3ARW	Braston, Frank, Jr.	3732 Locust St., Philadelphia, Pa.	.5
3ARF	Beck, Page M.	300 Minor St., Richmond, Va.	.5
3ARL	Belt, Wm. B.	Hyattsville, Md.	.5
3ASF	Blaess, Geo.	2106 N. 5th St., Philadelphia, Pa.	.5
3ARD	Brautigam, Harry G.	5714 American St., Philadelphia,Pa.	.5
3ASM	Britt, Chas. J.	Arlington, Pa.	.5
3AOR	Cook, Chas. F.	Yardley, Pa.	.5
3ARE	Cullin, E. N.	1762 Willard St., Washington, D.C.	.5
3ASD	Damon, Lester R.	2517 N. 9th St., Philadelphia, Pa.	.5
3ARH	Drexel Radio Club	Drexel Institute, Philadelphia, Pa.	.5
3QY	Frank H. Stewart Elec. Co.	37-39 N. 7th St., Philadelphia, Pa.	.5
3ARM	Flumerfelt, E. Clinton	Polkville, N. J.	.5
3AOP	Gilbert, Clifford W.	1620 N. 17th St., Philadelphia, Pa.	.5
3ARI	Gillen, John J.	2134 Christian St., Philadelphia, Pa	.5
3ART	Harvey, Walter E.	233 N. Broad St., Trenton, N. J.	.5
3ARN	Hunt, Harry L.	1006 Wilkesbarre St., Easton, Pa.	.5
3ARP	Hunter, H. Clifford	226 E. Lancaster Ave., Wayne, Pa.	.5
3ASK	Jordan, Pendleton A., Jr.	339 Main St., Suffolk, Va.	.5
3ARG	Kelley, Ray F.	1042 S. Paxon St., Philadelphia, Pa.	.5
3ASP	Lewis, John C., Jr.	4014 Penhurst Ave., Baltimore, Md	.5
3AOS	Lister, Robert W.	102 Overbrook Ave., Trenton, N. J.	.5
3ASI	Marts, Harvey	836 Central Ave., Ocean City, N. J.	.5
3ASG	McKnett, Robert R.	3147 W. Gordon St., Philadelphia, Pa.	.5
3ARS	McNair, Wm. D.	1933 Biltmore St., Washington, D. C.	.5
3ASA	Milner, Robert D.	3335 Tennyson St., N. W., Washington, D. C.	.5
3ASN	Minnick, Otis	42 Fairview Ave., Cumberland Md	.5
3AOM	O'Brien, Francis J.	2226 N. Carlisle St., Philadelphia, Pa.	1
3RM	Phillips, John D.	612 N. 2d St., Reading, Pa.	1
3ARK	Radio Association of Maryland	Bancroft Rd., Arlington, Md.	1
3AOT	Ratcliffe, Wm. E.	352 Brunswick Ave., Trenton, N.J.	.5
3AOW	Roethlinger, Chas. A.	431 W. Susquehanna Ave., Philadelphia, Pa.	.5

THIRD DISTRICT—(Cont'd).

Call signal	Owner of station.	Location of station.	Power kilowatts.
3ARA	Shaw, R. Russell	207 High St., Burlington, N. J.	.5
3UD	Silvers, Frank H., Jr.	430 Princeton Ave., Trenton, N. J.	.5
3ASH	Snape, Edwin A., Jr.	318 W. Logan St., Philadelphia,Pa.	.5
	Stewart Electric Co.	Philadelphia, Pa. (See Frank H. Stewart Elec. Co.)	
3AON	Strang, Harry L.	2020 1st St., N. W., Washington, D. C.	.5
3ASL	Tallmadge, Richard H.	Chatham, N. J.	.5
3ASO	University of Pennsylvania	Philadelphia, Pa.	.5
3ARO	Wight, Donald M.	1620 29th St., Washington, D. C.	.5

FOURTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
4DR	Brantley, Lewis B.	534 5th St., N., St. Petersburg, Fla.	.5
4DS	Edwards, W. Leroy	32 Prospect Pl., Atlanta, Ga.	.5
4DO	Stalnaker, Leo	6th Ave., and 33d St., Tampa, Fla.	.5
4DQ	Tabb, Vincent W.	A. & M. College, West Raleigh,N.C.	1
4DP	Warner, Geo. C.	609 Swann Ave., Tampa, Fla.	1

FIFTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
5DX	Ancell, Tom B.	927 N. Marsalis Ave., Dallas Tex.	1
5ED	Autry, Jas. L., Jr.	5 Courtlandt Pl., Houston, Tex.	1
5EF	Baker, Chas. M.	507 N. 1st St. Temple, Tex.	.5
5CS	Beauchamp, Fred	Orange, Tex. (Boy Scouts Station)	.5
	Boy Scouts of America	Orange, Tex. (See Beauchamp, Fred)	
5DR	Caine, Irving D.	2211 Avenue H., Ensley, Ala.	1
5EB	Carrie, Robert G.	746 Herron St., Montgomery, Ala.	.5
5DY	Downing, Roswell B.	727 E. 6th St., Oklahoma City,Okla	.5
5DU	Emerson, Bennett	3730 Wendelkin St., Dallas, Tex.	1
5EG	Hudson, Edward M.	608 W. 7th St., Austin Tex.	.5
5DV	Hunt, Martin L.	Woodrow St., Dallas, Tex.	1
5EI	Kelly, Paul R.	3707 Junius St., Dallas, Tex.	.5
5EA	McDonnell, J. S., Jr.	3304 8th Ave., Little Rock, Ark.	.5
5DT	Reeves, Ben	2822 Turney Ave., Dallas, Tex.	.5
5EC	Reymond, Dalton S.	442 N. Boulevard, Baton Rouge,La.	.5
5AB	Steddom, A. Henry	1524 W. 9th St., Oklahoma City, Okla.	1
5DQ	Stanton, Roy	1002 Cedar St., Bonham, Tex.	.5

SIXTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
6GU	Anzini, Daniel I.	Mountain View, Cal.	.5
6NY	Bagley, Wm. C.	615 Johnson St., Santa Rosa, Cal.	.5
6LR	Baker, Jesse E.	2913 Lorina St., Berkeley, Cal.	1
6TG	Blodgett, Harry O.	1953 Bonsallo Ave., Los Angeles, Cal.	.5
6LZ	Burgess, Chas. W.	506 N. Philadelphia St., Anaheim, Cal.	.5
6NM	Carter, Kenneth L.	633 W. H. St., Colton, Cal.	1
6KN	Davidson, Geo. A.	Chula Vista, Cal.	1
6HY	Davidson, Merritt T.	1954 Hillcrest Rd., Hollywood, Cal.	.5
6RX	Dieterich, Martin	430 E. 12th St., Los Angeles, Cal.	.5
6LQ	Duborg, Geo.	845 Sierra St., Reno, Nev.	.5
6TQ	Emmerton, Alfred	167 S. 4th St., Sawtelle, Cal.	.5
6LM	Erler, Robert J.	114½ Santa Clara St., Vallejo, Cal.	.5
6LT	Farolita, Dominic A.	289 Chenery St., San Francisco,Cal.	.5
6BZ		1035 E. 1st St., Santa Ana, Cal.	.5
6RW	Garver, Oliver B.	1960 Vista Del Mar, Hollywood, Cal.	.5
6HX	Hare, Robert J.	1238 W. 38th St., Los Angeles, Cal.	.5
6RR	Herman, Edward W.	735 19th St., San Diego, Cal.	.5
6JC	Homand, Jas. A.	1423 McKinley St., Los Angeles, Cal.	.5
6MI	Hooper, Herbert D.	Sultana, Cal.	.5
6SX	Johnson, Alfred E.	1030 Delaware St., Berkeley, Cal.	1
6QV	Kimm, Geo. N.	2502 Q St., Bakersfield, Cal.	.5
6OF	Kroman, Robert	Napa, Cal.	.5
6BX	Lankston, J. M.	152 Ohio Ave., Sawtelle, Cal.	1
6MW	Lauritsen, Albert M.	Napa, Cal.	.5
6KU	Mealer, Loyal D.	Walnut Grove, Cal.	1
6KP	Miller, Murray R.	15 E. Central Ave., Redlands, Cal.	1
6QA	Myers, Harry	3215 N. Broadway, Los Angeles, Cal.	.5
6KB	Olmstead, Chas. B.	259 N. 23d Ave., Los Angeles, Cal.	.5
6JZ	O'Neill, Frank M.	1635 Addison St., Berkeley, Cal.	1
6JX	Pollitt, Chalmer L.	663 W. 35th Pl., Los Angeles, Cal.	.5
6HZ	Roe, Chas D.	661 S. Chicago St., Los Angeles,Cal.	.5
6HU	Rutledge, Ralph	401 10th St., Colusa, Cal.	.5
6OZ	Sanford, J. Gordon	1117 W. 78th St., Los Angeles, Cal	.5
6FZ	Schroeder, Arthur R.	Mountain View, Cal.	.5
6NO	Spaulding, Leland J.	172 32d Ave., San Francisco, Cal.	.5
6NZ	Spicer, Clarence	1005 Riverene Ave., Santa Ana, Cal	.5
6TT	Stewart, Francis S.	1919 Fern St., San Diego, Cal.	.5
6MZ	Stoudt, Frank L.	340 Francis St., Pomona, Cal.	.5
6OB	Telmont, Hippolyte B.	Mayfield, Cal.	.5
6KX	Thomas, Courte D.	2801 La Salle Ave., Los Angeles, Cal.	1

SEVENTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
7QD	Benoit, Neville R.	869 S. 41st St., Tacoma, Wash.	.5
7BA	Bischoff, Clarence L.	7417 53d Ave., S. E., Portland,Ore.	.5
7BT	Boslair, Orin E.	Vancouver, Wash.	.5
7LE	Bracht, Leon E.	Calabar, Mont.	.5
7MK	Callender, Melville H.	593 15th St., Astoria, Ore.	.5
7CT	Carpenter, Edward L., Jr.	119 E. 5th St., Aberdeen, Wash.	.5
7SG	Gianelli, Salver A.	517 E. Sharp Ave., Spokane, Wash	.5
7ND	Grush, David R.	383 19th St., Astoria, Ore.	.5
7RI	Hager, Clement S.	1019 E. 54th St., Tacoma, Wash.	.5
7OC	Heifort, Earle R.	707 Lincoln St., Port Townsend, Wash.	.5
7GP	Hunter, Guy A.	518 Willow St., Port Townsend, Wash.	.5
7JP	Jolly, Chas. W.	507 Prospect Ave., Lewiston, Idaho	.5
7ML	Mason, Howard F.	3566 Morgan St., Seattle, Wash.	.5
7CU	McDermott, Thomas H.	339 26th Ave., Seattle, Wash.	.5
7WP	Ralston, Graham W.	Port Townsend, Wash.	.5
7JS	Ramsay, James S.	215 E. 9th St., Ellensburg, Wash.	.5
7FR	Rush, Floyd M.	930 S. 13th St., Salem, Ore.	.5
7MR	Spikder, Emmet E.	715 10th St., Lewiston, Idaho	.5
7VA	Vreeland, Thad	210 Graham Ave., Portland, Ore.	1
7KM	Watkins, Leslie W.	Wheatland, Wyo.	.5
7SI	Weagle, S. A.	2006 Cove Ave., La Grande, Ore.	.5
7WL	Wilson, Herbert A.	365 14th St. Astoria, Ore.	.5

(Continued on opposite page.)

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of March, 1916. (Continued.)

EIGHTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
8CD	Benz, Carroll	326 S. 5th Ave., Ann Arbor, Mich.	.5
8CM	Bieber, Carl W.	16 Hauf St., Buffalo, N. Y.	.5
8GY	Birkel, Lawrence J.	700 Tibbets Ave., Springfield, O.	.5
8TQ	Brooks, Clarence H.	278 Emerson St., Rochester, N. Y.	.5
8UQ	Leary, Robert	27 Inwood Pl., Buffalo, N. Y.	.5
8FQ	Phelps, Raymond W.	203 N. Almer St., Caro, Mich.	.5
8CE	Reeves, Arthur A., Jr.	288 Emerson St., Rochester, N. Y.	.5
8HN	Schlegel, Raymond G.	1118 N. Negley Ave., Pittsburgh, Pa.	.5
8HF	Weemhoff, S. J.	1152 Lafayette Ave., S.E., Grand Rapids, Mich.	.5
8EM	Wilkinson, Howard E.	239 Blaine Ave., Buffalo, N. Y.	.5
8TR	Yaeger, Henry	1036 N. Clinton Ave., Rochester, N. Y.	.5

NINTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
9FV	Aldrich, Clinton P.	6405 Emerald Ave., Chicago, Ill.	.5
9ADY	Clapp, Newell	Ellsworth, Wisc.	1
9ADT	Hartmann, Gilbert and Martin	210 State St., Wauwatosa, Wisc.	1
9ADW	Hicks, Verner	306 E. Marion St., Marion, Ill.	1
9ADV	Joslin, Murray	Independence, Iowa	1
9ADZ	McDonald, Edgar J.	5526 Lakewood Ave., Chicago, Ill.	.5
9EO	McNeill, Malcom R.	1310 Maple Ave., Evanston, Ill.	.5
9ADX	Roe, Vancil V.	Pillsbury Academy, Owatonna, Minn.	1
9ADS	Spalding John G.	1328 Brook St., Louisville, Ky.	.5
9ADR	Wallace, Wm. A.	Brush, Colo.	1
9ADU	Whitaker, Ralph S.	1823 S. Washington St., Denver, Colo.	1

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of April, 1916.

FIRST DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
1ENK	American Radio Ass'n.	8 Cedar Court Wakefield, Mass.	.5
1ESP	Bradshaw, Norwood V.	56 Elm St., Putnam, Conn.	.5
1ESM	Brennan, Edward G.	Bedford St., Stamford, Conn.	.5
1ENT	Brothers, Geo. W.	78 Central St., Hudson, Mass.	.5
1ESB	Byron, Myles	52 W. Liberty St., Waterbury Conn.	.5
1ESF	Feeney, Elton O.	181 Allen Ave., Portland, Me.	.5
1ENH	Grenier, Leonard J.	43 Hamlet Ave., Woonsocket, R. I.	1
1ESG	Hampton, Wm. G.	107 Grove St., Fall River, Mass.	.5
1ESO	Howard, Frank W.	38 Main St. Dexter, Me.	.5
1ENP	Kollen, Henry T.	996 Eddy St., Providence, R. I.	.5
1ESD	Lyman, Charles F., Jr.	Dover, Mass.	.5
1ESJ	Morrill, Donald H.	424 Wethersfield Ave., Hartford, Conn.	.5
1ESL	Morris, Joseph A.	56 Cedar St., New Britain, Conn.	1
1ESE	O'Neill, John D.	Leonard St., Stamford, Conn.	.5
1ESI	Phelan, Harold	35 Cedar St., Wakefield, Mass.	.5
1AS	Sheffield, Irving J.	25 Warren St., Hallowell, Me.	1
1ESN	Wright, Ira H.	12 Closson St., Methuen, Mass.	.5

SECOND DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
2APX	Baker, Alvah L.	253 W. 116th St. New York, N. Y.	.5
——	Barron Ave. High School	Woodbridge, N. J. (See Love, John H.)	
2AQM	Borax, Isidor	226 W. 121st St., New York, N. Y.	.5
2APR	Carpenter Stephen C.	273 S. Main St., Hempstead, N. Y.	.5
2AQJ	Clarkin Wm.	2416 Morris Ave., New York, N. Y.	.5
2AOK	Class, Charles L.	38 Vernon Ter., East Orange, N. J.	.5
2AAQ	Drury, Frank	21 Amherst Ave., Jamaica N. Y.	.5
2AV	Eastern District Y.M.C.A.	179 Marcy Ave., New York, N.Y.	.5
2LE	Egolf, Richard S.	1122 49th St., Brooklyn, N. Y.	.5
2AOO	Erven, Raymond P.	Keansburg, N. J.	.5
2AQC	Gardner, Wm. E.	15 Prospect St., Adams, N. Y.	.5
2DO	Guldi, Walter E.	Sayville, N. Y.	.5
2DD	Hammond Fremont M.	160 E. Main St., Patchogue, N. Y.	.5
2APN	Hausrath, Alfred H.	1866 Cedar Ave., New York N. Y.	.5
2ADG	Hegmegee, Joseph O. L.	235 River Drive, Garfield, N. J.	.5
2AOL	Horn, Charles W.	379 Broadway, Far Rockaway N. Y.	.5
2BW	Hynes, Eugene	2429 Valentine Ave., New York, N. Y.	.5
2AQD	Ingalls, Howard S.	Hamilton, N. Y.	.5
2AQB	Jacquet, Lloyd	478-A 16th St., Brooklyn, N. Y.	.5
2APH	Kalbach, Charles	2211 Andrews Ave., New York, N. Y.	.5
2AOH	Kleppe, Arthur	189 Inwood Ave., Montclair, N. J.	.5
2APQ	Knight, Harold E. H.	251 Fenimore St., Brooklyn, N. Y.	.5
2AQE	Langan, Daniel J.	513 16th St., Brooklyn, N. Y.	.5
2APJ	Lauterborn, George E.	68 N. Lark St., Albany, N. Y.	.5
2KG	Layng, Grant	841 St. Nicholas Ave., New York, N. Y.	.5
2AQL	Love, John H.	Barron Ave., High School Building, Woodbridge N. J.	.5
2AQH	Palmer, Thos.	18 Fulton St., Newark, N. J.	.5
2AQE	Phelps, Charles H., Jr.	459 W. 140th St., New York, N. Y.	.5
2APM	Purvis, Harry	500 W. 173d St., New York, N. Y.	.5
2APP	Prinz, Peter J.	28 Hanson Pl., Jamaica, N. Y.	.5
2APK	Schedler, Herbert D.	1024 Summit Ave., Jersey City, N.J.	.5
2AQG	Scott, Walter F.	207 N. 11th St., Newark, N. J.	.5
2APD	Skinner, Wm.	Ridgewood Ave. and Spruce St., Richmond Hill, N. Y.	.5
2AQI	Smejkal, Harry	1349 1st Ave., New York, N. Y.	.5
2APO	Tyler, Burnett	79 Winthrop St., Brooklyn, N. Y.	.5
2APL	Urban, Charles B.	113 Washington St., Westfield, N.J.	.5
2APS	Wiendieck, Elmer C.	Merrick, N. Y.	.5
2API	Williams, E. Harvey	547 Clifton Ave., Newark, N. J.	.5
2APT	Woodman, Malcolm W.	New York University, New York, N. Y.	.5
2APF	Woolley, Harrison	569 W. 173d St., New York, N. Y.	.5

THIRD DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
3CK	Baer, Francis M.	1744 Corcoran St., N. W., Washington, D. C.	.5
3ATI	Bayne, C. Armistead	14 Moran Ave., Norfolk Va.	1
3DN	Bertolet, Benjamin, Jr.	2112 Columbia Ave., Philadelphia, Pa.	.5
3CQ	Finger, Russell W.	448 Royden St., Camden, N. J.	.5
3ATH	George, John R.	5150 Knox St., Philadelphia, Pa.	.5
3AFK	Lohr, Allen W.	2122 Flagler Pl., N. W., Washington, D. C.	.5
3DJ	McCarter, Wm. F.	4718 N. Camac St., Philadelphia, Pa.	.5
3AER	Weber, James N.	111 3d St., Milville, N. J.	.5

FOURTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
4DV	Nelson, Wayne M.	Kernersville, N. C.	.5
4DW	Swinson, Alton H.	Little River, Fla.	.5

FIFTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
5DE	Ernest, Walter C., Jr.	119 St. Stevens Ave., Mobile, Ala.	.5
5EK	Hirsh, Leon	911 Fremont Ave., Muskogee, Okla.	.5

FIFTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
5CU	Miller, Harold L.	1012 Government St., Mobile, Ala.	.5
5EL	Smith, Leo H.	3161 Fetzer St., Shreveport, La.	.5

SIXTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
6VL	Bell, Oran M.	453 Isabel St., Los Angeles Cal.	.5
6KC	Bolton, Herbert J.	417 Park View St., Los Angeles, Cal.	.5
6OH	Bonham, Carlton L.	R. F. D. No. 1, Linden, Cal.	.5
6WP	Brown, Norman C.	Reno Power House, Reno, Nev.	1
6CC	Canfield, Carleton E.	169 High St., Santa Cruz, Cal.	.5
6VN	Carter, Robert F.	101 Ralston St., Reno, Nev.	.5
6TZ	Christenson, Howard	426 Palm Ave., Burbank, Cal.	.5
6DI	Cookson, Howard A.	361 14th Ave., San Francisco, Cal.	1
6DA	Davis, Clarence	909 W. Walnut St., Santa Ana, Cal.	.5
6FN	Deetkin, Frederick, I.	1535 6th St., Alameda, Cal.	.5
6AD	Diamond, Alfred	2015-A Sacramento St., San Francisco, Cal.	.5
6WH	Fabling, Walter D.	3624 2d Ave., Los Angeles, Cal.	.5
6AT	Heer, Alphonsus A., Jr.	134 Marsh Ave., Reno, Nev.	.5
6TE	Hueter, Noble G.	1434 Jones St., San Francisco, Cal.	.5
6VY	Kreiss, Rudolph L.	1062 Stannage Ave., Berkeley, Cal.	1
6LF	Lohry, Ross B.	1932 Irving Ave., East Oakland, Cal.	1
6CA	Lowell, Charles H., Jr.	1403 Martel Ave., Los Angeles, Cal.	.5
6EN	Miller, Elmer	1346 La Brea St., Los Angeles, Cal.	.5
6WM	Ludlow, Wm. B.	2320 Cedar St., Berkeley, Cal.	.5
6LA	Parker, Ralph	Lockeford, Cal.	.5
6LX	Parkin, John, Jr.	22 Terra Dillo Ave., San Rafael, Cal.	1
6OJ	Peterson, Frank E.	2615 Virginia St., Berkeley, Cal.	.5
6EG	Poage, Edward A.	143 15th St., Richmond, Cal.	.5
6UZ	Schellenback, Ray	1223 San Julian St., Los Angeles, Cal.	.5
6TV	Seitel, T. Benton	Chino, Cal.	.5
6CK	Spenser, Edward R.	1640 23d Ave., Oakland, Cal.	1
6ST	Spencer, Howard E.	Rivera, Cal.	.5
6SA	Spencer, Oscar J.	33 Douglas St., San Francisco, Cal.	.5
6JS	Squires, John E.	1605 Arch St., Berkeley, Cal.	.5
6BK	Talbott, Paul H.	740 S. San Antonio Ave., Pomona, Cal.	.5
6QZ	Urban, Carl H.	320 Maple St., Reno, Nev.	.5
6JI	Wagnon, Earl B.	Los Altos, Cal.	.5
6JV	Worthington, Jack	548 37th St., Oakland, Cal.	.5
6TY	York, Darwin E., & Guy A.	1001 W. 1st St., Santa Ana, Cal.	.5

SEVENTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
7DB	Bolstad, Archie L.	1832 4th Ave., W., Seattle, Wash.	.5
7QF	Chaffee, Arthur L.	3637 Woodland Park Ave., Seattle, Wash.	.5
7NC	Clodfelter, Nolan A.	1221 E. Madison St., Portland Ore.	.5
7SD	Schurch, Edward C.	Deer Lodge, Mont.	.5
7SJ	Stewart, Gleen R.	111 W. 8th St., Ellensburg, Wash.	1

EIGHTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
8AKC	Bain, Ovid	1731 E. Center St., Marion, Ohio.	.5
8ACT	Baumgardner, Donald G.	Demster, N. Y.	.5
8IY	Bidwell, Paul	9990 Euclid Ave., Cleveland, Ohio (has 2 stations)	1 1
8WP	Bidwell, Paul	11397 Glenwood Ave., Cleveland, Ohio.	.5
8AAJ	Brice, Wm. E.	714 W. Market St., Lima, Ohio.	.5
8NY	Brown, Fred C.	Port Clinton, Ohio	1
8VZ	Burchard, Wm. K.	77 Hastings Ave., East Cleveland, Ohio.	.5
8AGM	Burtis, Melvin M.	191 Goulding Ave., Buffalo, N. Y.	1
8WO	Bush, Richard A.	255 Main St., Binghamton, N. Y.	1
8AAP	Brown, Stanley E.	1 Aurora St., Lancaster, N. Y.	.5
8AIY	Carroll, Stanley W.	312 2d St., Marietta, Ohio.	.5
8ABG	Caswell, Frank A.	21 Dekalb St., Dayton, Ohio.	.5
8AIL	Conrad, Mark	117 East Crawford St., Van Wert, Ohio.	1
8AGC	Donahue, James B.	Horseheads, N. Y.	.5
8ADZ	Euler, John F.	253 Mellon St., Pittsburgh, Pa.	.5
8NC	French, Samuel W.	10 Fargo Ave., Ashtabula, Ohio.	.5
8WD	Fox, Edmund H.	271 Calumet Ave., Detroit, Mich.	.5
8WY	Hardesty, Howard P.	1186 Canton Ave., Detroit, Mich.	.5
8OO	Hummel, Richard O.	1606 Grace Ave., Lakewood, Ohio.	.5
8ADH	Lee, Harry H.	Memphis, Mich.	.5
8AEN	Manning, Stuart M.	527 Mitchell St., Petoskey, Mich.	.5
8UE	Motz, Leo	St. Augustine's School, Cincinnati, Ohio.	1
8AKB	Pickens, Willard H.	209 Hazelwood Ave., Ensworth, Pa.	1
8AFK	Robertson, Adelbert R.	7938 Tioga St., Pittsburgh, Pa.	1
8AAF	Robinson, David L.	513 Freeport Rd., New Kensington, Pa.	.5
8WM	Slocum, Charles	170 Annadale Ave., Akron, Ohio.	.5
8AKD	Staunton, R. E.	587 Dewey Ave., Rochester, N. Y.	.5
8ABI	Stellwagen, Arthur	312 E. Jefferson St., Ann Arbor, Mich.	.5
8AIP	Tatman, Harley C.	Continental, Ohio	.5

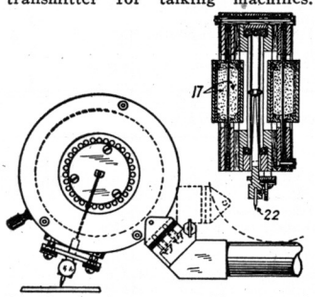
(To be continued.)

LATEST PATENTS

Microphonic Reproducer for Phonographs

(No. 1,185,877; issued to John J. Comer.)

Clever design of double microphonic reproducer and telephonic transmitter for talking machines.

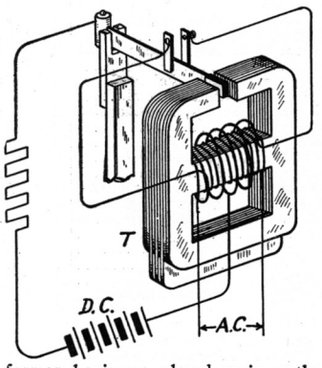


Needle 22 rests on disc record, while sound vibrations set up by central diaphragms react acoustically on two microphones 17, 17. Diaphragms are specially mounted in felt, etc., to prevent extraneous sounds from affecting them. This microphonic translator is now used with 110 volt current and yields excellent results.

Vibrating A. C. Rectifier

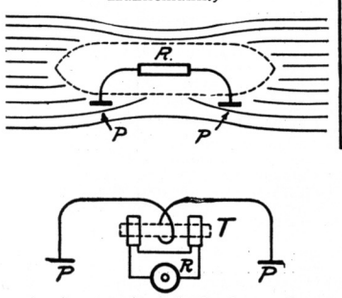
(No. 1,888,157; issued to John T. Dempster.)

The combination in A.C. to D.C. rectifying apparatus of a transformer having a closed main path for the magnetic flux and a shunt path for the magnetic flux having an air gap therein, the two paths being coincident only in the portions covered by the transformer windings, and a movable armature having a free end located in the gap so as to be actuated by the alternating magnetic flux set up in the shunt path as seen.



Submarine Telegraphy Scheme

(No. 1,190,156; issued to Walter Hahnemann.)

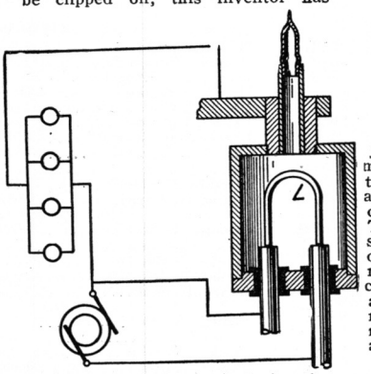


An improved method of carrying on telegraphic and telephonic communication by conduction through water to vessels, etc. Two metal plates, submerged, and near a metal hull, will not pick up sufficient current to work an ordinary receptor, as they are "shunted" by the hull. If the receiving circuit, however, is made to have a very low resistance by utilizing a step-up transformer with a one-turn primary, which "turn" is part of a heavy wire joining the submerged plates, then good results can be obtained, the inventor states. A telephone receiver may be placed in the multi-turn secondary circuit.

Alternating Current Rectifier

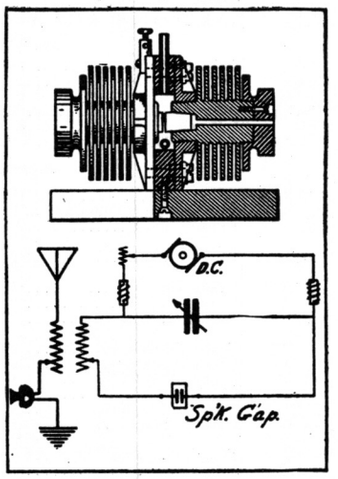
(No. 1,189,738; issued to Owen W. Richardson.)

On the theory that an incandescent body emits large quantities of negative electrons, and thus causes half pulses of an A.C. passing from the hot to a cold electrode to be clipped off, this inventor has evolved a rectifier for changing A.C. into D.C. The heated filament is enclosed in an evacuated metal chamber, which may contain hydrogen. The filament when coated with lime possesses a greatly enhanced ability for emitting electrons. A negative pulse can pass from the hot filament to the cold cylinder but not vice versa.



Quenched Gap Radio System

(No. 1,189,791; issued to Emory Leon Chaffee.)

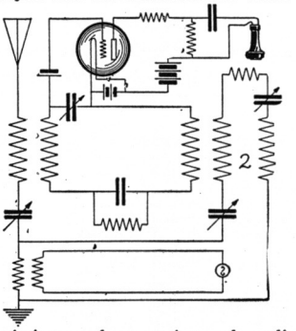


A new form of quenched spark or arc gap designed for use on direct current circuits in the manner here shown. The metal sparking electrodes are held by large ribbed, ventilating members for cooling. The gap proper is air-tight and may be saturated with hydrogen gas through tubes indicated. This gap is adapted to produce extremely high frequency oscillations suitable for radio-telephony. Undamped oscillations have been obtained with it having a wave length of 20 meters, or a frequency of 15,000,000 cycles per second.

Duplex Wireless System

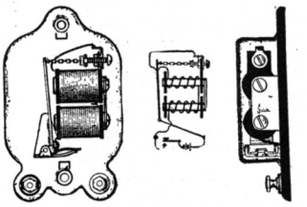
(No. 1,188,531; issued to John R. Carson.)

A duplex wireless system based on the fact that two resonant frequencies or wave lengths are employed for the simultaneous transmission and reception of radio messages, to one of which the transmitting system proper is tuned, and to the other of which the receiving system proper is tuned. The receiving system is carefully screened from electromagnetic induction emanating from the transmitting system. Auxiliary branch circuit 2 gives the system two resonant wave lengths. Detector cannot be "killed" by heavy transmitting current as coupling coils act differentially in such an event.



Electric Buzzer

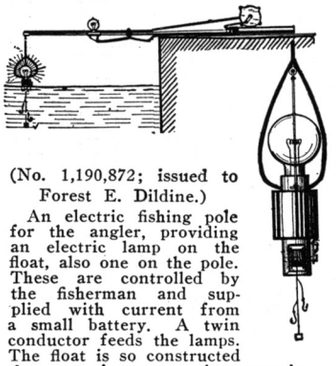
(No. 1,190,608; issued to Richard I. Utter.)



The inventor of this simple electric buzzer claims that by utilizing a fine link chain as indicated for creating a variable resistance in the circuit that he eliminates expensive contacts, and, moreover, that this buzzer is extremely simple in construction; most positive in operation and less likely to get out of order. These claims seem rather dubious.

Electric Fish-Pole

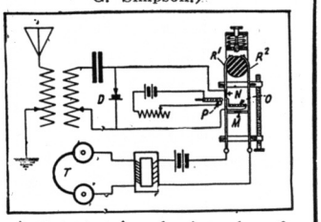
(No. 1,190,872; issued to Forest E. Dildine.)



An electric fishing pole for the angler, providing an electric lamp on the float, also one on the pole. These are controlled by the fisherman and supplied with current from a small battery. A twin conductor feeds the lamps. The float is so constructed that a twine connection carrying the usual hooks, etc., may be attached to its underside, and arranged so that the length of twine may be adjusted as desired. A novel wrinkle for those who fish at night. You can't miss the float when it "bobs."

Radio Relay

(No. 1,189,881; issued to Frederick G. Simpson.)

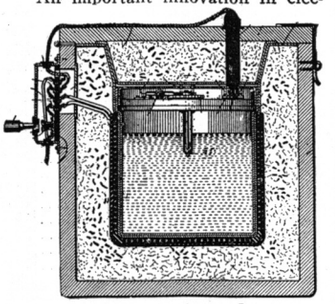


A tuned microphonic relay for receiving radio-telegraphic signals. An ordinary circuit is used to tune to the wave length; a crystal or other detector sends rectified impulses into coils N and O. Two tuned reeds R_1 and R_2 are vibrated by the A.C. field from N and O, acting in a D.C. magnetic field from coil P. A microphone M controls a transformer primary circuit as seen, the secondary circuit actuating the head 'phones T. When tuned the reeds of the microphone M respond to a certain group frequency only. They can be tuned by an adjusting screw.

Electrical Cooker

(No. 1,188,734; issued to Edward E. Clement.)

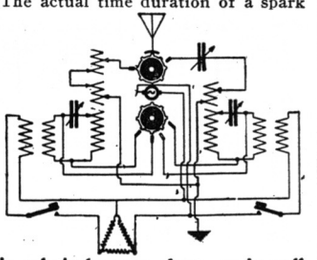
An important innovation in electrical cookers of the "fireless cooker" type, using either inbuilt electric heating elements or removable heaters. Also timing and and temperature cut-off attachments by which the current supply will be cut off when the temperature has reached a certain, predetermined value, or after the victuals have cooked for a certain length of time. Heat proof linings are used as in the fireless cooker with a consequent high efficiency.



Multiplex Radio Scheme

(No. 1,189,070; issued to Burr V. Deitz.)

A multiplex radio transmitting scheme providing a system whereby two or more messages or signals can be transmitted from a common aerial system or apparatus with relatively high efficiency and without interference between the messages or signals. A common alternator carries synchronous rotary spark gaps, one of which discharges in the time interval during which the other gap is dead. The actual time duration of a spark is relatively very short, as is well known. More transmitting circuits can be used with the common aerial as desired, utilizing of course a suitable spacing and positioning of the gap electrodes.



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Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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FELIX DOMESTICA OF CATAPILLA, CONNECTICAT

CATSTATIC GENERATOR

Spifilication of Patent Postals **Patent Aplitefor**

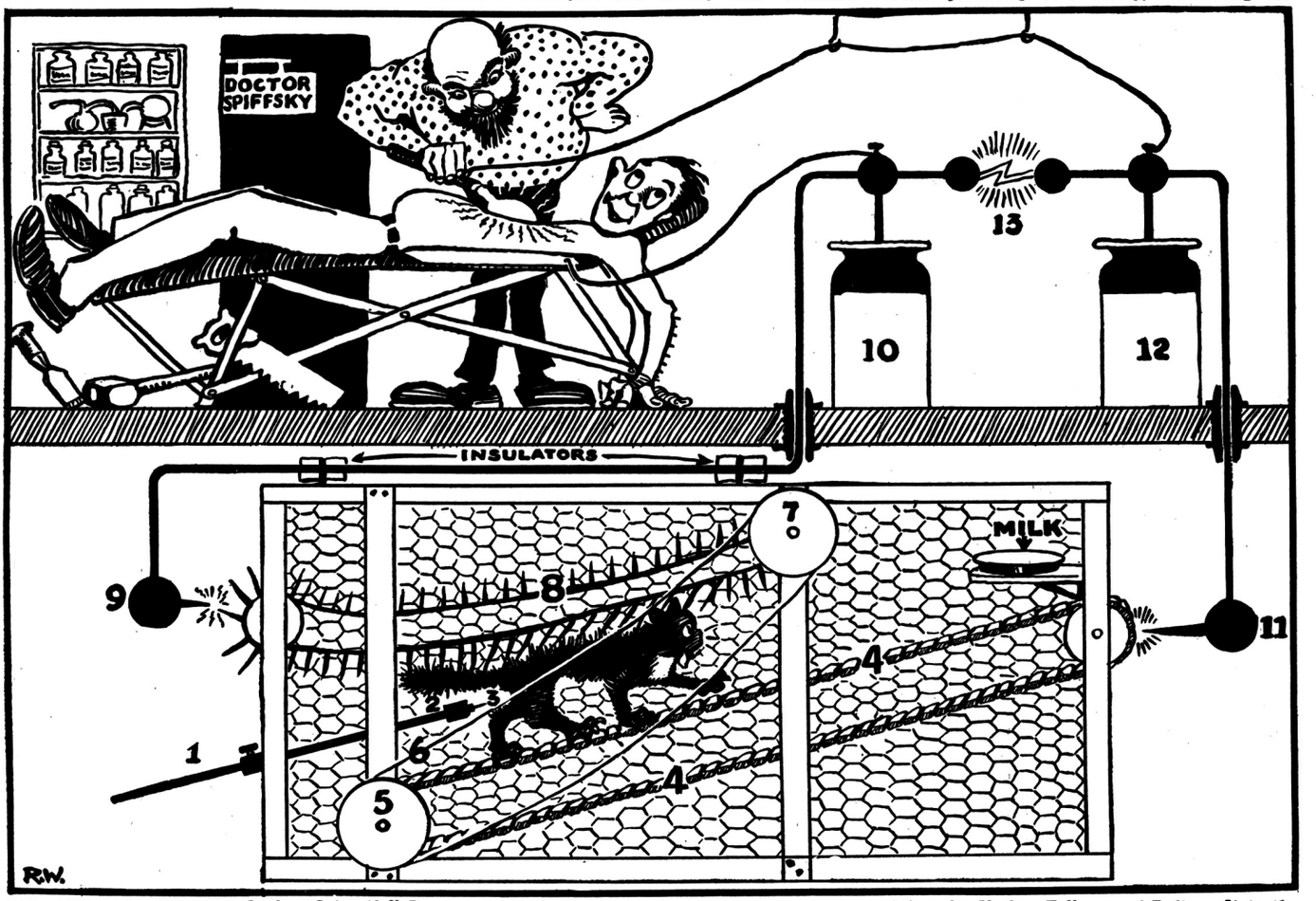
To Whoom it Might Conserve:

Be it knowed that I, Felix Domestica, of the city of Catapilla, in the state of Connecticat, have constructed, invented, and otherwise created certain useful improvements on domesticated felines, which will have the most revolutionary consequences on the world's supply of electricity.

It is an uncontrovertible fact, already propounded by the Egyptians, that outside of being musical, especially at nights, cats do not in any wise lighten the burden of man. They perform no useful work, but prefer to live on the rat of the land. Statistics need cats practice nocturnal *cat*aphonics, producing *cat*aclysms in *cat*acombs, resulting in *cat*aplexy of the listeners and in subsequent *cat*aracts of *cat*chup bottles with attending *cat*astrophies.

While there are a myriad of uses to which the liberated catelectricity can be profitably employed, the accompanying specification shows only one application, namely the supplanting of the physician's static machine, by means of my new Catstatic Generator.

In elucidating the automatic action of this apparatus the petitioner presupposes that one of the slumber destroyers has already been obtained.



A Most Promising Invention Is the "Catstatic" Generator. It Accumulates the Electrical Energy from Otherwise Useless Felines and Delivers It to the Physician's Gouty Instrument as Here Shown and Set Forth.

also show that could we extract all of the inherent as well as inherited free electricity from all of the living cats, kittens and pussycats, we would obtain enough energy to run all the electric street cars in this country for 26 hours, 12 minutes and 64 seconds.

It has remained to your petitioner to develop a machine which at once lifts all the cats from the unproductive class into the beloved sweatshop class. No longer need valuable energy be lost, no longer

First rod (1), sliding in a hole in the center of a door at the end of the narrow cage, is pulled out until block (2) carrying pin (3) prevents further motion. Then the door is opened and the credulous cat is introduced and adjusted to the best lines of commutation by an arrangement which, like the rest of the machine, is very simple. The rod (1) is slowly but firmly pushed forward until the *motive power* has been urged about half way up the inclined plane formed by the endless belt (4) and is secured at that point by a set screw provided for that purpose so that the feline may be instantly invigorated whenever it slackens its pace.

The competent kitty, incited by the saucer of milk ahead as well as by the point of the prodding pin behind, endeavors to move forward and in so doing causes the belt (4) to move in the opposite direction. This motion is transmitted by means of pulley (5) and belt (6) to pulley (7), thus causing the hard rubber combs, fastened at regular intervals on belt (8), to pass through the cat's fur and in this way obtain a negative (—) charge of electricity. As each comb passes collector (9) it gives up this charge, which is then conducted to Leyden jar (10). Likewise the positive (+) charges, which appear simultaneously with the negative ones, pass through the body of the cat to the brass strips attached on belt (4), are carried by them to collector (11) and are finally stored in Leyden jar (12). As soon as the potential becomes sufficiently great, sparks will jump across gap (13).

What I claim is: 1° A cat operates static generator producing *cat*electricity, eliminating *cat*acoustics as well as *cat*alepsy in a *cat*egorical manner in *cat*tle as well as in humans.

In testimony whereof, in the presence of taxicab tormentors, I affectionately affix my superannuated striped suspenders, this April Fool's Day in the twenty-third year after the advent of the "Ford."

(Signed) Felix Domestica.

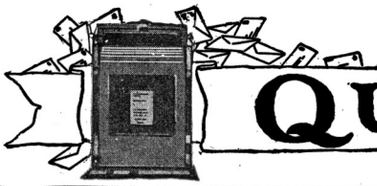
By his attorney, John M. Downie.
Brainerd, Minn.

Witnesses:

Watchu Handinus.

I. M. Pickelt.

Kwityer Kidden.



QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

MOTOR QUERIES.

(624.) P. Muldrid, Spokane, Wash., wishes to know:

Q. 1. How can one tell the amount of power developed by a motor when it is in regular service, driving machinery?

A. 1. If the motor can be disconnected from the regular load and a brake applied, the efficiency may be determined for dif ferent currents. Then by measuring the current and voltage while it is working under its regular load, and multiplying by the efficiency of the motor for such a load, we can determine the power being delivered.

Q. 2. Does the resistance of the armature have much to do with the amount the speed slows down?

A. 2. The less the resistance of the armature, the more nearly the counter electro-motive-force equals the line voltage, and the less reduction of C.E.M.F. necessary to allow the greater current to pass. Hence the speed of the motor will be more constant for varying loads as the resistance of the armature is less.

Q. 3. How can the counter electro-motive force be measured?

A. 3. It cannot be measured directly. It can be calculated by taking the difference between the total pressure at the terminals of the armature and the product of armature current by the measured resistance of the armature.

RHEOSTAT.

(625.) John Golby, Richmond, Va., asks the following questions:

Q. 1. For what purpose are rheostats used?

A. 1. They are connected into the field magnetizing circuits of dynamos to regulate the electromotive force of the generator; they are used in series with motors to make them start slowly. Rheostats are sometimes used to vary the difference of potential between the terminals of apparatus connected to constant potential circuits.

Q. 2. How much energy may be dissipated in a water rheostat?

A. 2. In general the current density should not exceed 1 ampere per square inch of electrode. Pure water is rarely used for the solution for potentials below 1000 volts. For these lower potentials sulphuric acid (use lead or carbon plates in the acid solution) or common salt (iron plates commonly used for salt solution) is added to the electrolyte to render it more conductive. It has been found that the radiation capacity of a liquid rheostat depends upon its volume and not upon the area of the exposed surface. It is usual to compute the capacity of a water rheostat on the basis of watts per cubic inches. A good rule is to consider 500 to 800 cubic inches of solution for every 746 watts (1-H.P.) to be absorbed continuously. For starting motors about 20 cubic inches per H.P. capacity may be allowed. Mr. H. W. W. Dix gives average values for watts per cubic inch as follows: for 30 degrees C. rise in temp., 1 watt per cu. in.; for 48 degrees C. rise in temp., 2 watts per cu. in.; for 60 degrees C. rise in temp., 3 watts per cu. in.; and for 67 degrees C. rise in temp., 4 watts per cu. in. By allowing cold water to circulate through the tank or barrel much higher current densities can be used. It requires $\frac{86.5}{t}$ kilograms or $\frac{190}{t}$ pounds of water per hour to dissipate the heat liberated by the absorption of one kilowatt with a temperature rise of "t" degrees centigrade. This rule applies also to the cooling of metallic resistors submerged in running water.

LAST CALL

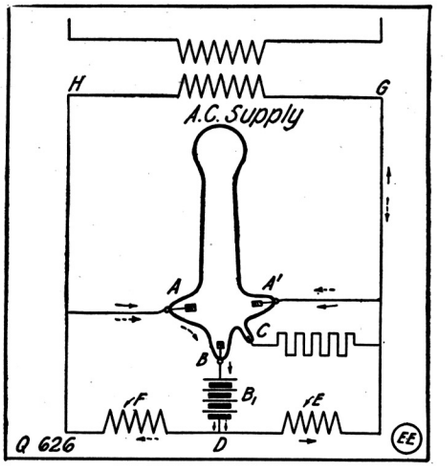
On November 1st, 1916, the subscription price of "The Electrical Experimenter" advances to $1.50 in U.S. (Canada $1.85, Foreign $2.00.) This is the last chance to subscribe at the old rates ($1.00 in U.S., Canada and Foreign $1.50). No subscription for more than five years at the old rate accepted. THE PUBLISHERS.

MERCURY RECTIFIER.

(626. S. Dantheury, Chicago, Ill., wants to know the following:

Q. 1. A description of the operation of a mercury arc rectifier.

A. 1. The accompanying diagram is an elementary diagram of connections. The rectifier tube is an exhausted glass vessel in which are two graphite anodes AA and one cathode B. The small starting electrode C, is connected to one side of the alternating circuit through a resistance, and by rocking the tube a slight arc is formed which starts the operation of the rectifier bulb. At the instant the terminal H of the supply is positive, the anode A is then positive and the arc is free to flow between A and B. Following the direction of the arrow still further, the current passes through the battery B_1, then one half of the main reactance coil E, and back to the negative terminal G of the transformer.



Circuits and Current Paths in Mercury Arc Rectifier. B_1 May be a Storage Battery Under Charge.

When the impressed voltage falls below a value sufficient to maintain the arc against the reverse voltage of the arc and load, the reactance E, which heretofore has been charging, now discharges, the discharge current being in the same direction as formerly. This serves to maintain the arc in the rectifier tube until the voltage of the supply has passed through zero, reversed, and built up such a value as to cause the anode A, to have a sufficient positive value to start the arc between it and the cathode B. The discharge circuit of the reactance coil E is now through the arc A. B is now supplied with current, partly from the transformer as indicated by the dotted line arrows.

ELECTROSTATIC INSTRUMENTS.

(627.) L. Pontpies, Seattle. Wash., inquires:

Q. 1. What is the operating principle of electrostatic instruments?

A. 1. The action of these instruments depends upon the fact that two conductors attract one another when any difference of electric pressure exists between them. If one be delicately suspended so as to be free to move, it will approach the other, providing the charges are of opposite polarity.

Q. 2. Describe the Kelvin electrostatic voltmeter.

A. 2. A simple form consists of a metal case containing a pair of highly insulated plates, between which a delicately mounted, paddle-shaped needle is free to move. When the needle is connected to one side of a circuit and the stationary plates to the other side, the needle is attracted and moves between them, the magnitude of the movement depending upon the amount of charge present.

DYNAMO QUERIES.

(628.) Frank Smith, Washington, D.C., asks:

Q. 1. How should a shunt or compound dynamo be started?

A. 1. All switches controlling the external circuits should be opened as the machine excites best when this is the case. If the machine be provided with a rheostat or hand regulator and resistance coil, these latter should all be cut out of the circuit or short-circuited until the machine excites, when they can be gradually cut in as the voltage rises. When the machine is giving the correct voltage as indicated by the voltmeter or pilot lamp, the machine may be switched into connection with the external circuit.

Q. 2. If a shunt generator will not pick up, what is likely to be the trouble?

A. 2. The speed may be too slow; the resistance of the external circuit may be too small; the brushes may not be in proper position; some of the electrical connections in the dynamo may be loose, broken or improperly made; the field may have lost its residual magnetism.

Q. 3. What is the indication that the connections between the field coils and armature are reversed?

A. 3. If the machine builds up when

(*Continued on page 434*)

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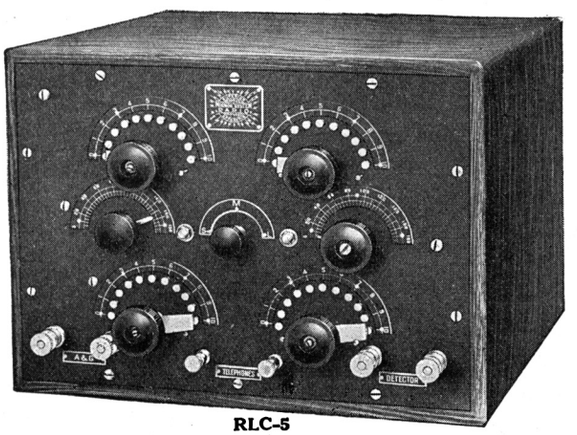

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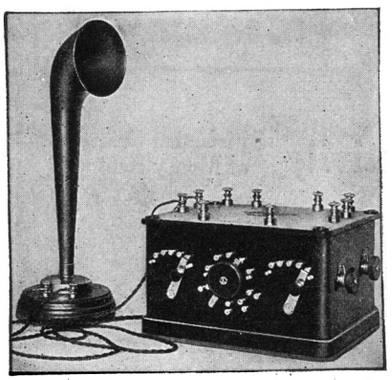

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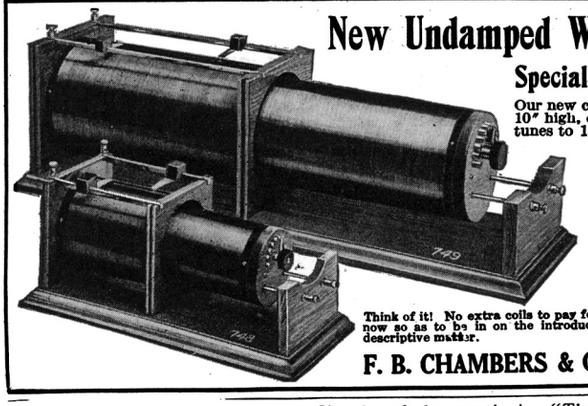

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We claim to be the original inventors of a SYSTEM or CIRCUIT for the reception of the undamped waves without the use of Loading Coils or Oscillating Coils, as they are sometimes called; as with our SYSTEM or CIRCUIT only two Inductively Coupled Coils are necessary. Circuit supplied with each coupler.

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F. B. CHAMBERS & CO., 2046 Arch St., Phila., Pa.

QUESTION BOX.

(*Continued from page 432*)

brought to full speed, the connections are correct, but if it fails to build up, the field coils may be improperly connected.

POLARIZATION IN BATTERY CELLS.

(629.) Paul Jones, Boston, Mass., asks:

Q. 1. How a primary battery is depolarized?

A. 1. A *depolarizer* is used as a rule to unite chemically with the gas, and form a substance that will dissolve in the liquid. For this purpose black oxide of manganese, oxide of copper, red lead, peroxide of lead, sulphur, bromine, chlorin, nitric acid and solutions of chromic acid, or bichromate of soda, and other similar oxidizing agents are employed. Some of these attack zinc, even when the circuit is open, and must be used with great care. The solid depolarizers generally work quite slowly and are used in cells for intermittent work on circuits that are generally open. Liquid depolarizers generally work rapidly and the cell may be used continually with but little diminution of the E.M.F.

Q. 2. What type of cells employ liquid depolarizers?

A. 2. These may be divided into two classes; those with single liquids and those with two. The former class is represented by the bichromate cells, the latter by the Bunsen batteries.

ELECTRO-CHEMICAL EQUIVALENT.

(630.) John Peterson, Baltimore, Md., wishes to know:

Q. 1. What is meant by the *electro-chemical equivalent?*

A. 1. The electro-chemical equivalent of an element is the amount liberated by one coulomb. Experiments show that one coulomb (1 ampere flowing for one second) will liberate .000010384 grams of hydrogen gas from water or other compounds. As hydrogen is the lightest element known, its weight is taken as unity for the basis of comparing the weight of atoms of other elements. The various elements are also classified according to their *valency* or the power they have in uniting with other elements. Thus one atom of oxygen will unite with two atoms of hydrogen to form one molecule of water; thus oxygen is said to have a valency of two and hydrogen one, while other elements have a valency ranging from 1 to 6. The electro-chemical equivalent of an element is therefore the atomic weight multiplied by .000010384 and divided by the valency. A simple expression for determining the value is

$$E = \frac{Aw}{V} \times .000010384$$

where

E=electro-chemical equivalent
Aw=atomic weight
V=valency

MAGNETIC QUERY.

(631.) Richard Johnston, Queens, N.Y., inquires:

Q. 1. What determines the number of ampere-turns necessary to magnetize a circuit to a desired intensity?

A. 1. This is determined by the length and area of the various parts of the circuit and by the permeability of each part, using the general equation:

$$\text{Magnetization} = \frac{\text{Magnetomotive force}}{\text{Reluctance}}$$

The development of the above expression is:

$$\Phi = \frac{\frac{4\pi Nl}{10}}{\frac{l}{Au}} = \frac{1.257\ NIAu}{l}.$$

Where: Φ=number of lines of force,
N=number of turns of wire,
A=area of the section of the magnetic circuit,
l=its length,
u=permeability of the iron.

In solving the equation in terms of N, so that it may be convenient in obtaining the number of ampere-turns, we get:

$$NI = \frac{l\,\Phi}{1.257\,Au}$$

This expression is given in C.G.S. units and if inches are used instead of centimeters the expression becomes

$$NI = \frac{\Phi l''}{A''u} \times .3132$$

If the magnetic circuit is uniform, the ampere-turns may be calculated directly from the above formula. If there are a number of unlike parts, the magneto-motive force (M.M.F.) for each part may be calculated and the sum of these gives the total number of ampere-turns.

RELUCTANCE.

(632.) L. Zehnder, Middletown, N.Y., wants to know:

Q. 1. What is meant by *reluctance?*

A. 1. The magnetic pressure (magneto-motive-force) acting in a magnetic circuit encounters a certain opposition to the production of a magnetic field, just as an electro-motive-force in an electric circuit encounters opposition to the production of a current. In the magnetic circuit the opposition is called reluctance; it is simply magnetic resistance and may be defined as the resistance offered to magnetic flux by the substance magnetized. It is the ratio of the magneto-motive-force to the magnetic flux.

Q. 2. Upon what does the reluctance of a magnetic circuit depend?

A. 2. The reluctance is directly proportional to the length of the circuit and inversely proportional to its cross-sectional area.

Q. 3. Does the reluctance depend upon the quality of iron used in the magnetic circuit?

A. 3. Yes.

CONDENSER CAPACITY.

(633.) Theo. S. Brown, Quincy, Mass., writes for:

Q. 1. The dimensions of an antenna series condenser that will reduce the wave length of a three wire aerial, 183 feet long and 35 feet high down to 200 meters?

A. 1. You need a condenser having a maximum capacity of .0164 mfd. It is not practical to make such a large reduction in wave length in this way.

KICK-BACK PREVENTERS.

(634.) Earl Henson, Philadelphia, Pa., writes:

Q. 1. Do you lower or increase the capacity by connecting two condensers in series? If so, in what proportion to the first capacity of each? If two .003 m.f. condensers are used in this manner, what is the combined capacity?

A. 1. You lower the total capacity of a group of condensers which are connected in series. The capacity is one over the reciprocal of the sum of the capacities of the individual condensers. The capacity of the combined condenser is .0015 m.f.

Q. 2. Which side of the meter, i.e., the street or the house, do you connect a kick-back preventer? Is this a condenser, resistance, or an inductance?

A. 2. It is connected to regular house mains after the meter. It is nothing more than a high capacity condenser with a micrometer spark gap, although a 10,000 ohm

(*Continued on page 438*)

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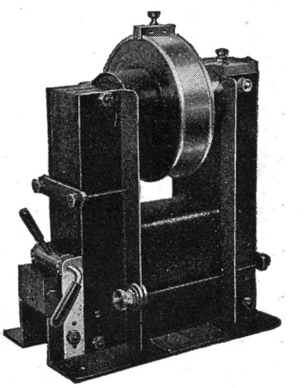

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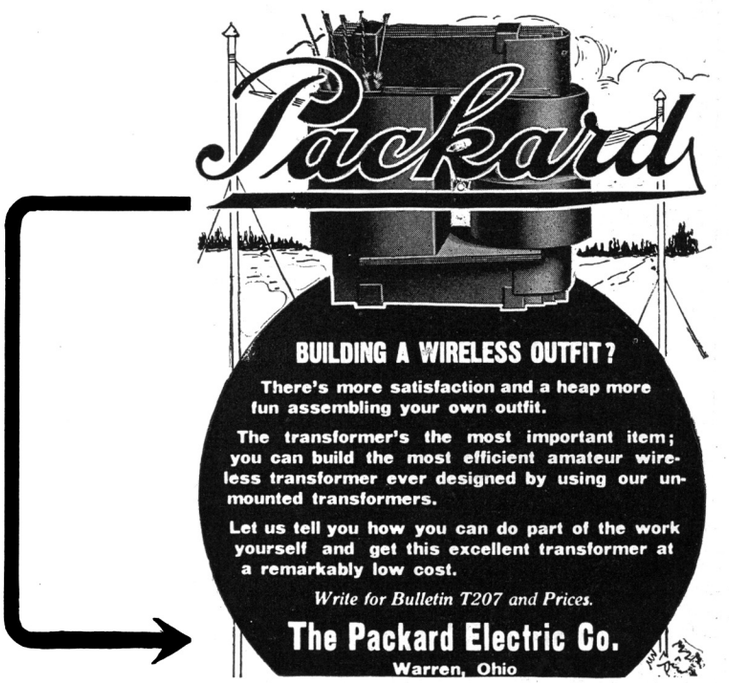

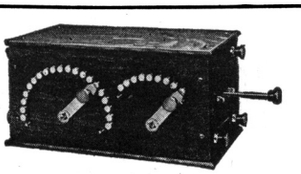

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E. I. Co., N. Y. Lanark, Ill.
My dear Sirs:
Regarding your new detector crystal *Radiocite* wish to advise that I have received the crystal. I have used and given same a careful test and *am surprised* at the results received with it. I really consider it a better grade of crystal *than any Galena I ever tried.* Although my station includes an Audion Detector, *I much prefer the Radiocite* for amateur work, for it is very easy to keep adjusted; NAA comes clear as a bell. I will be glad to recommend your crystal to anyone.
Yours very truly,
E. H. GIDDINGS
Radio Station 9MK., Lanark, Ill.
Telegraph Operator, C. M. & St. P. Ry.

The E. I. Co., Owego, N. Y.
New York, N. Y.
Gentlemen:
I have thoroughly tested your, *Radiocite*, and find it very stable *withstanding very severe static* and holding a very sensitive adjustment for several days without touching on a table subjected to considerable jarring. Another detector setting beside it would not hold its adjustment but for a short time. It is easy to adjust, and of the several kinds of minerals used by me I consider it the most sensitive. I would recommend *Radiocite* to all amateurs and others who desire a detector easily adjusted, very sensitive, and one which will hold its *adjustment indefinitely and stay sensitive.*
Yours respectfully,
H. G. SMITH.

E. I. Co., N. Y. Littleton, Mass.
Dear Sirs:
That *Radiocite* crystal is one of the best I have used. The first time I tried it stations came in great, some I had never heard before. I hear N.A.A. so loud that I can lay the phones on the desk and hear them. Very truly yours, JACK HARDY

St. Paul's M. E. Parsonage,
E. I. Co., N. Y. Penn's Grove, N. J.
Dear Sirs:
I received my *Radiocite* O. K. and have had splendid results with it. It brought in signals clearer than *Galena* or other minerals I have used. I think it will please everybody.
WM. OGBURN LYNCH

E. I. Co., N. Y. Le Roy, N. Y.
Dear Sirs: June 21st
I have thoroughly tested the *Radiocite* which I received from you and find it far superior in all respects to *Galena, Silicon* or any other mineral I have ever used.
Respectfully yours,
WM. N. TOWNER

E. I. Co., N. Y. 729 Euclid Ave.,
Dear Sirs: Baltimore, Md.
I could not express my satisfaction with the new mineral *Radiocite. It is more sensitive than any crystal detector* I have ever tried. It is also permanently sensitive and *is not knocked out by the ½ K.W. open core transformer* which I use for sending. I remain your true friend,
W. J. POHLMAN

404 Mt. Prospect Ave.,
E. I. Co., N. Y. Newark, N. J.
My dear Sirs:
I received your tested *Radiocite* and find it excellent. As soon as I received it, I put it in the cup, put the detector spring on and N.A.H. came in so loud he could be read *sixteen feet from the phones.*
Yours truly, HENRY D. WILSON, JR.

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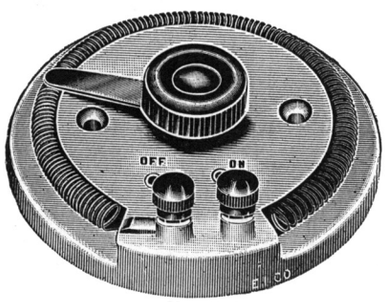
236 Fulton St., N.Y.

Electro-Best

MADE IN AMERICA

The "Electro" Rheostat-Regulator
PORCELAIN BASE

PATENTED FEB. 1, 1910



No. 5000

The only Rheostat on the market with Center Rotary Action.

This little current regulator makes a valuable addition to any wireless set where it is used to regulate the battery current. ESPECIALLY WITH VACUUM DETECTORS.

With battery lamps it is very valuable, where it is used to prevent the lamps from burning out on account of too strong a current, etc.

Advantages over other small rheostats: gradual and accurate regulation of current; great current capacity; little heating, resistance coil air-cooled; no concealed parts; impossible to get out of order. PORCELAIN BASE. CANNOT BURN OR CHAR.

The wire used in this regulator is the finest high resistance wire. It will positively not rust, break nor bend, even under a constant load of 3 amperes. This we guarantee in every instance. The groove which holds the spiral is ( ) shaped (PATENTED), which makes it impossible for the coil to fall out or become dislocated. Large hard rubber handle (1 inch in diameter) is provided, allowing rapid and smooth turning of switch blade.

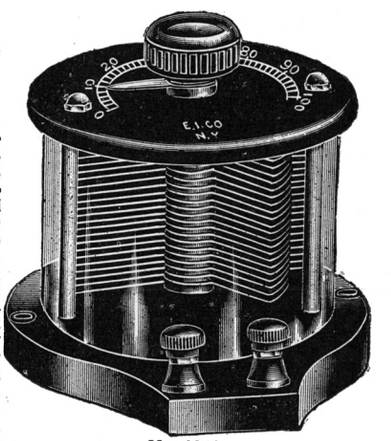
Resistance is 10 ohms. Maximum capacity, 3 amperes continually; size, 4 inches diameter, thickness of base 13/16 inch.

No. 5000. Rheostat-Regulator (patented). Price.... $0.60
Shipping weight, 2 pounds.

The Pride of Every Amateur

The "Electro" Rotary Variable Condensers

Consider these features: FIRST—THESE CONDENSERS ARE THE ONLY ONES MADE WITH A TRANSPARENT CASE IN WHICH OIL CAN BE USED WITHOUT IT LEAKING. In this way the condenser capacity can be increased FIVE TIMES. SECOND—THIS CONDENSER IS THE ONLY ONE NOW ON THE MARKET WITH CONNECTIONS AT THE BOTTOM. Cover is of highly polished hard ruber composition with a large scale that is easily read.



No. 9241

No. 9240. "Electro" Rotary Variable Condenser, 17 Plates, size 4⅛x3⅞ inches. $2.50
Shipping weight, 2 pounds.

No. 9241. "Electro" Rotary Variable Condenser, 43 Plates, size 4⅛x3⅞ inches, $4.00
Shipping weight, 3 pounds.

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1/2 inch THICK -- WEIGHT 1/2 lb. -- 658 ILLUST.

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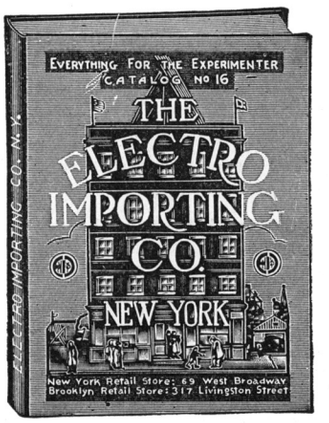
It contains the largest assortment of Wireless and electrical experimental apparatus shown in any catalog published. In addition are shown Commercial Wireless Sending and Receiving Outfits, Electric Motors, Dynamos, Flashlights, Medical Batteries, High Frequency Apparatus, Plating Outfits, Toys, Printing Presses, Tools, Sporting Goods and the LARGEST Scientific Book section published. This book will give you as much information as many books that cost you $1.00 or more. It contains 658 illustrations, 2,000 articles, complete Code Chart of Morse, Continental and Navy Codes, sixteen-page "TREATISE ON WIRELESS TELEGRAPHY," list of Call Letters of U. S. Government and Commercial Ship and Shore Wireless Stations, besides a great many useful tables and formulas. This valuable book is 7 x 5¼ inches in size and ½ inch thick, and well bound.



Size 7x5¼"--2000 Articles

It is sent free for 4c. to cover postage only.

Some of the questions answered in Cyclopedia Catalog No. 16:

The Wireless Law of August 13, 1913.
How to Receive Wireless Messages.
How Far You Can Telephone by Wireless.
Wave Lengths of Principal Radio Stations.
How to Erect a Wireless Aerial.
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How to Photograph Electrical Discharges.
How to Experiment with Spark Coils.
How to Test Storage Batteries.
How to Make Tesla Experiments.
Call Letters of all Commercial and Government Wireless Stations.

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236 Fulton Street, New York City.

I enclose herewith 4 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 16 containing 275 pages, 658 illustrations and diagrams, including Treatise on Wireless Telegraphy, complete list of all U. S. Wireless Call Letters, and 20 coupons for your 160 page Free Wireless Course in 20 lessons.
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And That Isn't All

When you receive the original copy there will be pages for personal accounts, station record, as well as easily detached memorandum pages.

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You surely want one of these. All you have to do to get one is send your name and address with ten cents in stamps or coin to Dept. C.

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Lombard, Illinois

EXPERIMENTERS!!
WE SPECIALIZE IN
SEAMLESS CARDBOARD TUBING
IN SIZES SUITABLE FOR
TUNING COILS, LOOSE COUPLERS, TESLA COILS, Etc.
SPECIAL GRAY TUBES
18"x6½"x6⅛" .75ea. 18"x7½"x7⅛" .75ea.
PRICE LIST
Smooth Wound Wireless Tubes

Outside Diam.	Lgth.	Price	Par. Post
3	x 7½	.10	.16
3½	x 7½	.10	.16
4	x 7½	.15	.22
4½	x 7½	.15	.22
5	x 7½	.20	.26
5½	x 7½	.20	.26
6	x 7½	.25	.32

GENERAL INFORMATION
These prices include PARCEL POST CHARGES: and are shipped at once on receipt of order and remittance. We CANNOT furnish these tubes in longer lengths than 7½" unless ordered in quantities of 100 of a size. We CAN furnish SPIRAL WOUND TUBES in any length up to 45 inches at .02 per inch in the following diameters, 3½-4-4½-5-6.
Send 2c. stamp for Price List
BEETLE & MACLEAN MFG. CO.
21 BROMFIELD ST. BOSTON, MASS.

25 WATT "WIRELESS" TRANSFORMER $15.00
Closed Core Type Self Contained 14,000 VOLTS 3 Different Powers Shipping Weight—20 lbs.
Folders and information descriptive of these ¼ K. W. transformers may be had for the asking—also of our 500 and 750 watt capacities.
Winger's Code Charts—large size **Continental—Post Paid—15c.**, small or pocket size **10c.** They enable you to learn the code **More Quickly** than by any other method.
Our New Detector (cat whisker type) is **"Some" Detector**—it is a marvel of simplicity and dependability—base is of **Vulcanized Fibre** and is furnished with **Two** crystal holders—one **Cupholder** and one **Looped Spring** holder—**Post Paid 50c. WINGER ELECTRIC & MFG. CO., 711 So. Dearborn St., Chicago Ill.**

BOSTON WIRELESS
Rotary Condenser, 43 plates, .001 M.F., $3.75
Tuner, $2.50. Spark Gaps, 60c. and $1.00
Detectors, $1.00, $1.75, $4.00
Loose Coupler, $7.50, 1500 Meters
Agent for A. W. Bowman & Co., Adams-Morgan Co. Manhattan Spark Coils. Catalogue for 2c. stamp.
M. MUELLER, 18 Devonshire Street, BOSTON, MASS

UNDAMPED WAVE INDUCTANCES
Do you hear the arc stations—WSL—NAA—WGG—POZ—OUI? If not, write us and let us tell you how you can, with your regulation receiving set. Tell us your troubles.
TRI CITY RADIO LABORATORY
508 Best Block Rock Island, Ill.

Can you use shop worn and second-hand instruments if the prices are right? If so investigate our BARGAIN department. Would you exchange any of your instruments for new ones if you could? Write Dept. A.
The Radio Distributing Company
Lombard, Illinois

QUESTION BOX.

(*Continued from page 435*)

carbon rod, connected across line, and grounded in the middle, is sometimes used.

INDUCTANCE COIL.

(635.) Gilbert Styler, Bellevue, Pa., wants to know:

Q. 1. Would an aerial 90 ft. high and 300 ft. long with three wires spaced 2 ft. apart be suitable for receiving undamped waves at the natural wave length.

A. 1. You should have no trouble in receiving stations emitting both undamped and damped waves, providing the proper instruments are used in the receiving station.

Q. 2. Please give directions for making inductance marked L in Fig. 1, page 254, August issue.

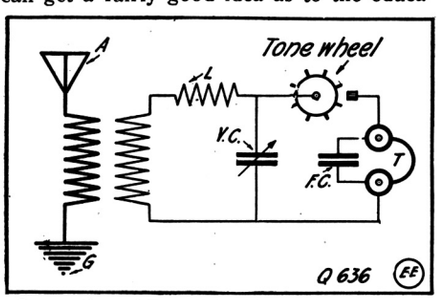
A. 2. The coil L is made by winding a single layer of wire No. 38 gauge upon an insulating tube 18 inches long by 5 inches in diameter. Twenty equal taps are taken from the coil to a multi-point switch so as to regulate the inductance.

METER ENGINEER.

(636.) Chester Shurr, Berthold, N.D., wishes to know:

Q. 1. How to become a Meter Engineer, necessary education, and salary.

A. 1. A meter engineer is practically a full-fledged electrical engineer with a special knowledge of measuring instruments, both in principle and operation. You are advised to consult the September issue of this magazine on page 328 where you can get a fairly good idea as to the education necessary to become an electrical engineer. An additional course is given in advanced measuring instruments where the student specializes in meter engineering.



Connection of Tone Wheel in Radio Receiving Set.

As to the salary, it entirely depends upon the man himself. A well versed and experienced meter engineer should have no trouble in making a salary of $1500 per year.

Q. 2. I wish to make a Goldschmidt tone wheel like the one described in a previous issue of *The Electrical Experimenter*. What metal must I use and what must be the size, shape and number of teeth in the wheel to receive Arlington, Sayville and Tuckerton, when using a Knapp type S S Dynamo-Motor run on 4 to 6 dry cells?

A. 2. The rotor of the tone wheel should be made from a steel disc 6" in diameter, with 400 teeth filed on its peripheral face. A small electromagnet is placed on one side of the wheel. The discs should be carefully mounted on the motor shaft and properly secured to same. The connections are given in the diagram. A resistance should be connected in series with the motor and battery so that the speed of the wheel can be regulated in order to receive the distant transmitting station.

ARLINGTON POWER.

(637.) Marvin Fallgatter, Waupaca, Wisc., asks:

Q. 1. Please publish a list of detectors, the most sensitive first and the others following respectively. Please include mineral detectors using different minerals in this list.

A. 1. Vacuum Detectors, Radiocite, perikon, Radioson, galena, silicon, carborundum and molybdenum.

Q. 2. Can iron be used as the lever and contacts of a lightning switch? If so what are the required dimensions?

A. 2. Iron can be used for constructing a lightning switch, but copper is the only material that the Board of Fire Underwriters will pass. However, if you desire to build one, you may use the same dimensions as the one made from copper.

Q. 3. What kilowatt rating and range has Arlington and some of the other government stations?

A. 3. Arlington is rated for 100 kilowatts, Brooklyn 2 to 5 K.W., Boston 10 K.W., Philadelphia 5 K.W., Norfolk 5 K.W., Key West, Fla., 10 to 25 K.W.

ELECTROMAGNET.

(638.) W. T. Saul, Lexington, Mass., inquires:

Q. 1. Can an electromagnet be used on an alternating current? If so, will it not flicker or will it be unperceivable?

A. 1. Yes, it will flicker, and the amount of flickering will depend upon the frequency of current supply.

Q. 2. In an induction coil can a direct current be induced into the secondary without a vibrator or circuit breaker? If so, would you get a direct current?

A. 2. It is impossible to induce a current in the secondary without the use of a vibrator or other form of circuit breaker. It is possible to induce a current in the secondary by supplying the primary with an alternating current and the current obtained from the secondary will be alternating, the periodicity of which will be the same as the primary current.

Q. 3. How can an alternating current be changed to a direct current?

A. 3. By the use of either a chemical, mercury, or mechanical rectifier.

EDISON STORAGE BATTERY.

(639.) Bernard Cohen, Brooklyn, N.Y., writes:

Q. 1. How are the plates of an *Edison* storage battery made? Also where could I get the chemicals and parts for the cell?

A. 1. The positive or nickel plate consists of one or more perforated steel tubes heavily nickel plated, filled with alternate layers of nickel hydroxide and pure metallic nickel in extremely thin flakes. The tube is drawn from a perforated ribbon of steel, nickel plated and reinforced with eight equidistant steel bands, which prevent the tube's expanding away from and breaking contact with its contents. The tubes are flanged at both ends and held in perfect contact with a steel supporting frame or grid made of cold rolled steel also nickel plated. The negative or iron plate consists of a grid of cold rolled steel, holding a number of rectangular pockets filled with powdered iron oxide. These pockets are made up of very finely perforated steel. After the pockets are filled they are inserted in the grid and subject to great pressure between dies which corrugate the surface of the pockets and force them into good contact with the grid. The plates are immersed in an electrolyte consisting of a 21% solution of potash in distilled water with a small per cent of lithia.

We would advise you to communicate with the Edison Storage Battery Co., at Orange, N.J., for material used in the manufacture of their cells. They will undoubtedly quote you a price on the material you desire.

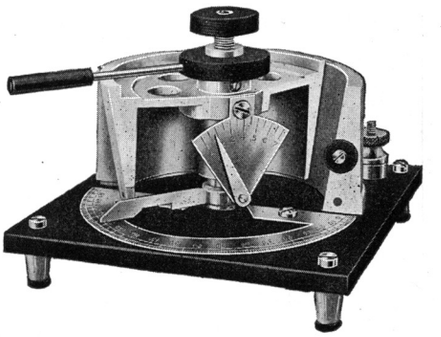
(*Continued on page 440*)

TURNEY TURNEY

The New Turney Vario Variable Condenser Has Seven Scales

10 Days' Trial Allowed

The new TURNEY VARIO VARIABLE CONDENSER is a real innovation in variables. It is seven complete Condensers in one, has seven different scales all of different maximum capacities and approaches an absolute zero heretofore unknown in Condensers. There are no plates to warp, therefore the instrument remains constant. The movable and stationary members are made of a special alloy which in appearance resembles silver and will not tarnish.



DIMENSIONS 6"x6"x3" SHIPPING WEIGHT 2 LBS.

SCALE READINGS

Scale No. 1-0 to .001 M.F. Scale No. 4-0 to .00012 M.F.
Scale No. 2-0 to .0005 " Scale No. 5-0 to .00007 "
Scale No. 3-0 to .00025 " Scale No. 6-0 to .000055 "
Scale No. 7-0 to .000035 M.F.

Price $8.00 POSTAGE EXTRA

10 Days' Trial Allowed

The new TURNEY VARIO VARIABLE CONDENSER is ideal for EXTREME MEASUREMENTS where absolute accuracy is demanded. It is incomparable for WAVE METERS and Regenerative Ionized Gas and pure Electron Detector circuits. The entire instrument (with the exception of the base which is of Bakelite) is engine turned and is made with the greatest care.

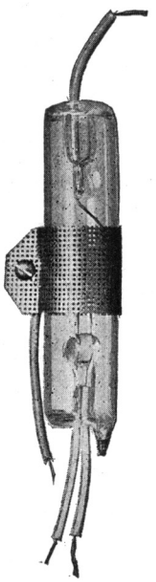
Don't buy a Condenser until you have seen the TURNEY VARIO VARIABLE.

EUGENE T. TURNEY CO., Inc., 2595 3rd Ave., New York

TURNEY TURNEY

The Moorhead Tube

Patent Pending



The MOORHEAD tube must not be confused with the two member valve, as it is inoperative without the outer electrode, or do not class it with the Trons or three member detectors as it is far more sensitive than either, in fact it is the most constant, stable and sensitive detector that has been developed.

A wonderful feature of the Moorhead tube is the static elimination. On the nights when static make the reception of stations with the ordinary detector impossible, the Moorhead tube brings the signals in with a marvelous clearness.

The initial cost of the Moorhead tube is low when the guaranteed long life is considered, and the fact that each Moorhead tube is a guaranteed

DETECTOR, AMPLIFIER and OSCILLATOR

SPECIAL INTRODUCTORY PRICE UNTIL JAN. 1, 1917

$6.50 PREPAID AND DELIVERY GUARANTEED

WE REPLACE ANY DEFECTIVE TUBES WITHOUT QUESTION

Write for circulars on the MOORHEAD tubes and Special sets

Pacific Research Laboratories, Sole Manufacturers

PACIFIC LABORATORIES SALES DEPARTMENT

534 Pacific Building SAN FRANCISCO, CALIF.

"You Get The Job"

"We've been watching you, young man. We know you're made of the stuff that wins. The man that cares enough about his future to study an I. C. S. course in his spare time is the kind we want in this firm's responsible positions. You're getting your promotion on what you *know*, and I wish we had more like you."

The boss can't take chances. When he has a responsible job to fill, he picks a man *trained to hold it.* He's watching ***you*** now, hoping you'll be ready when the opportunity comes.

The thing for you to do is to start today and train yourself to do some one thing better than others. You can do it in spare time through the International Correspondence Schools. Over 5000 men reported advancement last year as a result of their I. C. S. training.

The first step these men took was to mark and mail this coupon. Make *your* start the same way—and make it right now.

I. C. S., Box 5321, Scranton, Pa.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 5321, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ SALESMANSHIP
☐ Electric Lighting	☐ ADVERTISING MAN
☐ Electric Car Running	☐ Window Trimmer
☐ Electric Wiring	☐ Show Card Writer
☐ Practical Telephony	☐ Outdoor Sign Painter
☐ Telegraph Expert	☐ RAILROADER
☐ MECHANICAL ENGINEER	☐ ILLUSTRATOR
☐ Mechanical Draftsman	☐ DESIGNER
☐ Machine Shop Practice	☐ BOOKKEEPER
☐ Gas Engineer	☐ Stenographer and Typist
☐ CIVIL ENGINEER	☐ Cert. Pub. Accountant
☐ Surveying and Mapping	☐ Railway Accountant
☐ MINE FOREM'N OR ENG'R	☐ Commercial Law
☐ Metallurgist or Prospector	☐ GOOD ENGLISH
☐ STATIONARY ENGINEER	☐ Teacher
☐ Marine Engineer	☐ Common School Subjects
☐ ARCHITECT	☐ CIVIL SERVICE
☐ Contractor and Builder	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ AGRICULTURE
☐ Concrete Builder	☐ Textile Overseer or Supt.
☐ Structural Engineer	☐ Navigator ☐ Spanish
☐ PLUMBING AND HEATING	☐ Poultry Raising ☐ German
☐ Sheet Metal Worker	☐ AUTOMOBILES ☐ French
☐ CHEMICAL ENGINEER	☐ Auto Repairing ☐ Italian

Name_____

Occupation & Employer_____

Street and No._____

City_____ State_____

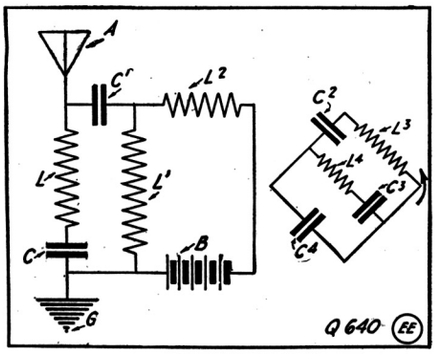
If name of Course you want is not in this list, write it below.

QUESTION BOX.

(*Continued from page 438*)

GOLDSCHMIDT HIGH FREQUENCY ALTERNATOR.

(640.) James Golaby, Paterson, N.J., asks for:



Circuits of the Radio Frequency, Goldschmidt Alternator.

Q. 1. A diagram of a Goldschmidt radio frequency alternator.

A. 1. The diagram here shows schematically the connections of the alternator.

Q. 2. What is the maximum frequency obtained with the present type machine?

A. 2. 40,000 cycles.

Q. 3. What is the clearance between the stator and rotor?

A. 3. About one millimeter.

ELECTRIC HEATING DEVICES.

(641.) A. Trowly, Schenectady, N.Y., wishes:

Q. 1. How much energy is required by electric heating devices?

A. 1. If you refer to 110 volt circuits, a 6½ pound sad-iron for common household use requires 4 amperes, or for laundry use where the work is rushed 5 to 6 amperes; a polishing iron requires 2.5 amperes and an 18 pound goose iron, 5 amperes; 4½ inch plate stove requires 1.9 amperes to make it hot in about two minutes. A larger disc heater 6 inches in diameter takes 5.5 amperes; a single griddle requires the same current, a three section griddle 6 amperes; a chafing dish will take 4 amperes and a small tea kettle 4 amperes to 7 amperes, an immersion coil for cooking food, boiling water or for heating water for special work takes from 4 to 8 amperes, according to the size; a heating pad for application to the body uses only .4 ampere, which is the same current as required for a curling iron. Soldering irons take 1 to 2 amperes, depending also upon the size of the device. The above currents are taken by heating devices on 110 volt circuits. For other voltages the resistances are proportional to absorb an equivalent amount of energy.

Q. 2. How do physicians use electric heat?

A. 2. They use it to some extent for heating poultices and pads to be applied to various parts of the body. They also use it for small incandescent lamps which may be introduced into or near various parts of the body for illuminating purposes and for sterilizing their instruments.

CHOKE COIL.

(642.) Peter Fuller, Chicago, Ill., asks:

Q. 1. What is a choke coil?

A. 1. A choke coil consists of a coil of wire surrounding a laminated iron core. It usually has several terminals so that the number of turns of wire in the circuit may be adjusted, or in some cases part or all of the iron core is movable so as to change the inductance of the circuit. The coil is connected in series with the circuit to be controlled.

Q. 2. For what purpose is a choke coil used?

A. 2. It is used for reducing the voltage and current in the circuit. The self-induction of the choke coil acts as a C.E.M.F. or back voltage opposing the impressed or line voltage and thus reducing the current. For example, a choke coil may be connected in series with a group of incandescent lamps in order to dim them. Choke coils are being used to a considerable extent for maintaining constant current in a series of arc lamps operated from a constant potential alternator; the inductance of the coil being adjusted to compensate any changes of resistance due to the feeding of the arc-lamp carbons.

MULTITONE TRANSMITTER.

(643.) Earl Putnam, Duluth, Mich., wishes:

Q. 1. Diagram of connections of a Lorenz Multitone transmitter.

A. 1. The diagram herewith gives the connections. The second oscillatory circuit CL⁴ shunted across the gap, is used for producing the different tones. These are varied by means of a multiple key board; each key is connected to a certain portion of the inductance coil as shown.

Q. 2. Has the decrement anything to do with the oscillation in a 60 cycle transmitter?

A. 2. Yes. It controls the amplitude of each oscillation and also the number of oscillations per group.

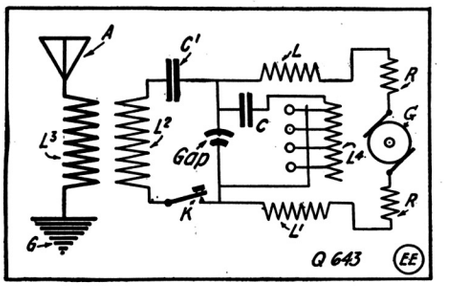
Q. 3. Would like to have an equation showing the relation between current and voltage amplitude in an undamped current of sinusoidal character.

A. 3. The formula for this is:

$$I_o = \frac{V_o}{\sqrt{R^2+(\omega L)^2}}:$$

where:

I_o=current in amperes,
V_o=voltage,
R=resistance,
L=self-inductance,
ω=angular velocity.



How Multiple Tones Are Made on the Lorenz Musical Spark Radio Transmitter.

WAVE LENGTH OF ANTENNA.

(644.) J. Edelon, Memphis, Tenn., asks:

Q. 1. What is the wave length of my aerial, composed of four wires 180 feet long, fifty feet high: the lead-in is 24 feet long?

A. 1. The natural wave length of your antenna is 460 meters.

Q. 2. How can a voltmeter be used to measure higher potentials than its ordinary range?

A. 2. The range of a voltmeter is doubled by placing it in series with an equal resistance. For example, if a voltmeter reading 50 volts has a resistance of 20,000 ohms, it will read to 100 volts when in series with an added resistance of 20,000 ohms. This is true only for instruments taking current, and does not hold true for electrostatic instruments. The reason is that an ordinary voltmeter is really a sort of ammeter with a high resistance and if the resistance of the circuit is doubled, twice as much pressure is required to send the same current

(*Continued on page 442*)

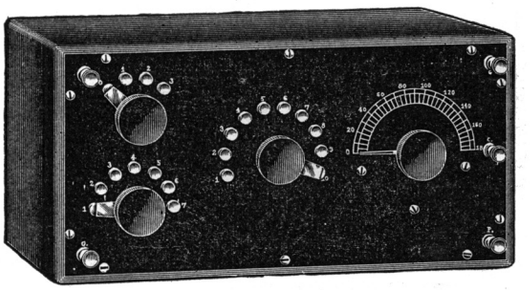
Wireless Apparatus MESCO of Known Quality

MESCO Short Wave Regenerative Receiver

Recommended for relay work on wave lengths of 180 to 450 meters. It is possible to receive wave lengths up to 1,000 meters with reduced amplification.

The circuit is the Armstrong regenerative with constants accurately calculated for the wave lengths when employed in conjunction with audion detectors.

Will receive undamped and damped waves.



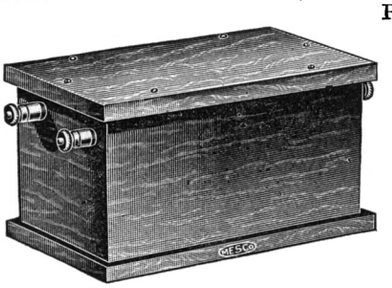
No. 8467—MESCO Short Wave Regenerative Receiver.....Price **$32.50**

Will increase receiving range of any station over 100 times.

Complete in every detail and ready for operation when connected to an aerial ground audion detector and telephone receivers.

A blue print of connections with detailed instructions for setting up and operating this receiver is supplied with each instrument. Oak cabinet.

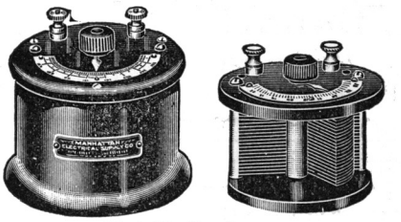
The metal parts are of brass, nickel polished.



Intensifying Transformer

Can be used with any crystal detector in connection with Audion. Signals can be intensified 10 to 25 times.

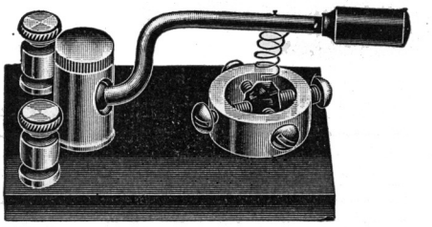
No. 224.....Price **$12.00**



Variable Condenser

Capacity .001 M. F. a thoroughly reliable and scientifically made instrument.

No. 294.....Price **$4.00**



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Remains permanently in adjustment. One of the most simple and effective Detector Stands made.

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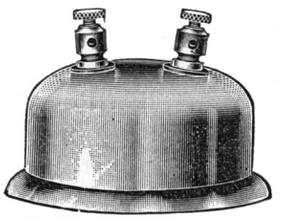

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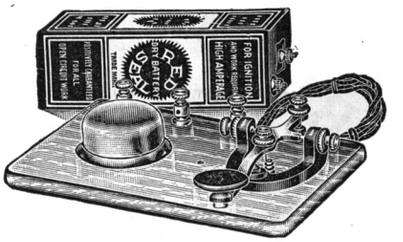

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The most perfect set made. Equivalent to five different sets. Supplied complete with Red Seal Dry Battery.

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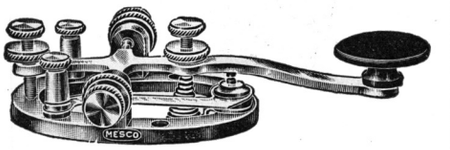

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The last word in efficient wireless key construction.

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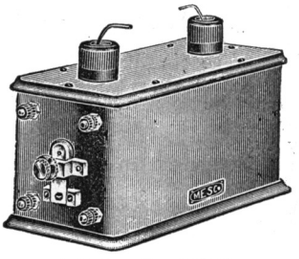

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Unquestionably the best on the market today. Best coil to use on Dry Batteries as the consumption of current is very low. Made in ¼-in. to 4-in. The 3-in. and 4-in. supplied with separate primary condenser.

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Very high grade. Can be used on 2000 miles. Extremely sensitive. 1000 ohms.

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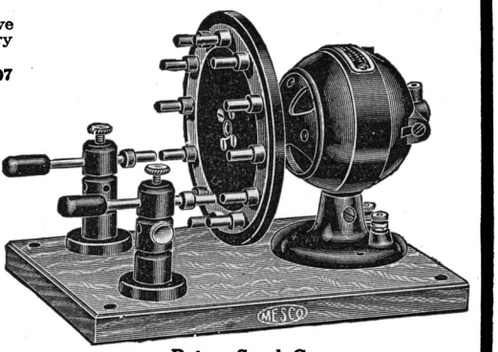

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Will increase the efficiency of any Transmitting Station 20 to 30 per cent. Has very high clear note. Can be used on spark coils or transformers up to 1 k.w. capacity.

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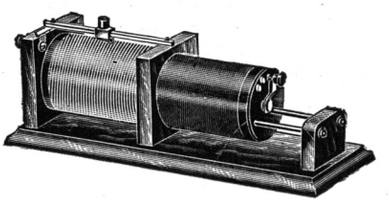

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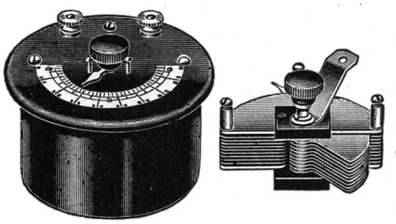

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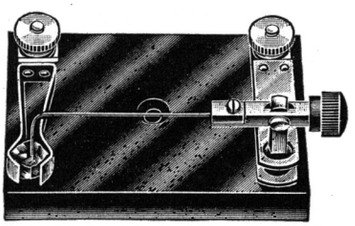

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The Mark-o' Quality

TYPE 6WT8

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Type	Volts	Amp. H.R Capacity	List Price	Special price to wireless engineers
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6C2	6	40	10.00	6.00
6C4	6	60	12.00	7.20
6C6	6	80	16.00	9.60

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Arnold Navy Model Loose Coupler

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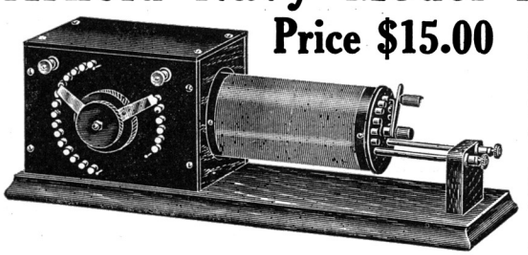

A customer said the other day: "Arnold, I have seen your Ad. in the magazine for months and had I known the instrument was as good as it is and looked so much better than the Cut I would have bought one sooner. I am glad I came to town and had a chance to take one in hand and see for myself."

Needless to say he bought one.

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Please Note NEW ADDRESS

J. F. ARNOLD, 327 East 119th Street, New York

QUESTION BOX.

(*Continued from page 440*)

through. By having several resistances, the voltmeter may be given any range desired. Such resistances are called multipliers. If a voltmeter having a scale reading to 100 volts and a resistance of 15,000 ohms is connected in series with a multiplier having 9x15,000 ohms, then its readings should be multiplied by 10.

Q. 3. What precautions are necessary to insure accuracy when measuring resistance with a voltmeter?

A. 3. Be careful that the voltage of the dynamo or battery does not change between the two readings; this can usually be checked by taking a second reading across the line with the voltmeter alone. Be sure also that the voltmeter is not affected by any external magnetic field from the circuit being measured. Also be sure that the wires and connections used do not have any appreciable resistance or the drop in them will have to be considered also.

MOTOR ARMATURE WITH DIAGONAL SLOTS.

(645.) R. Miller, New York City, writes for information:

Q. 1. Concerning what he believes to be an undue magnetic action and end-play, consequent from the use of staggered or diagonal slots on a D. C. motor armature.

A. 1. We do not believe there is any unusual end-thrust produced by this arrangement of the armature slots. You can readily prove this, providing you have a fairly large end-play between the shoulders on the armature shaft and the bearings. Allow the armature to lie either forward or backward from its normal, central polar position, and you will observe that when the field current is suddenly turned on that the armature will immediately center itself, longitudinally, between the pole pieces. The editor of this column has observed this in a number of instances and the staggering of the armature slots not only lowers the *magnetic hum* as you mention but also it allows the armature inductors or wires to enter and leave the magnetic field gradually and not suddenly. It thus causes a much smaller amount of sparking at the commutator brushes. Also the constancy of the turning effort or torque is much higher than in the common form of armature with straight slots, placed parallel to the axis of the armature shaft.

ORIGIN OF THE TERM "ELECTRICITY"

Millions of people of to-day who are living in an electrical age, undoubtedly do not know where the term *electricity* originated, and how people came to use the word universally to signify that power which performs all the myriad wonders that we see daily all about us.

From ἤλεκτρον (Elektron), the Greek name for *amber,* is derived the word *electricity,* which is now extended to signify not only its power of attracting light bodies when it is agitated by rubbing with silk, fur, etc., but other powers connected with it, in whatever bodies they may be communicated.

The attractive nature of electrified amber is occasionally mentioned by Pliny and other later naturalists; particularly by Gassendus, Kenelm, Digby and Sir Thomas Brown.

Very exhaustive experiments have been carried out by William Gilbert, a native of Colchester, and a physician at London, who, in his excellent Latin treatise "De Magnete," published in the year 1600, relates a great variety of electrical experiments, which were allied in nature to the properties possessed by amber. He has disclosed

(*Continued on page 444*)

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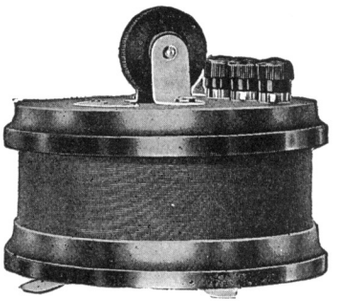

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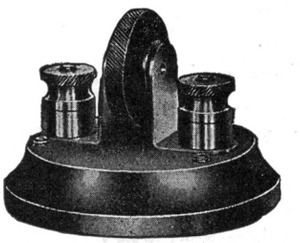

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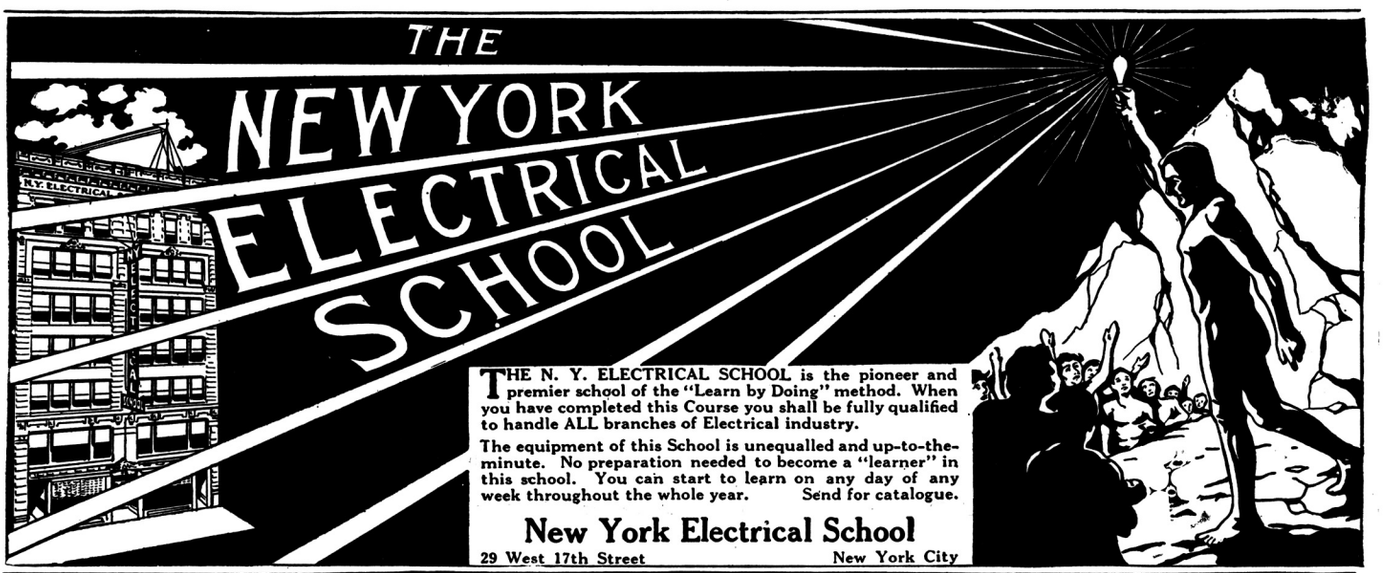

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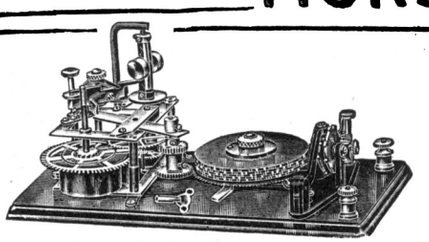

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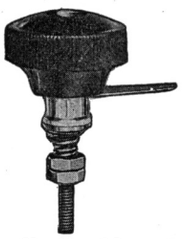

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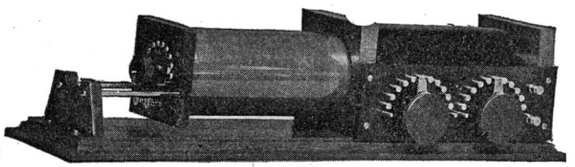

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ORIGIN OF THE TERM "ELECTRICITY."

(*Continued from page 442*)

several of the substances which had these peculiar properties of attracting light bodies when agitated by a material.

Amber was used by the ancient world as a jewel for decoration. Its color and luster reminded the fanciful Greeks of the virgin gold which glistened in the hands of Pactolus; even as the brilliant metal itself had recalled to them the yellow sunshine. Afterwards they applied the same name to the compounds of metals which, when burnished, have a golden glow. They were all children of the sun "Elector"—reflecting in miniature its radiance. Thus in common with native gold and the silver-gold alloys, the amber, in Hellenic speech, came to be called "Elektron."

Dr. Gilbert has found various other substances capable of attracting light bodies when rubbed, similar to the remarkable property of amber, which he called "Electrics." Ever since his time, the name "Electricity" has been employed to denote the characteristic property possessed by these substances and all the other manifestations of a similar nature with which we are all more or less familiar to-day.

THE MEANING OF PH.D., B.SC., AND E. E.

While many of us no doubt are fairly familiar with the abbreviated marks of learning, such as Ph.D., appended to the names of some of the authors contributing articles to the THE ELECTRICAL EXPERIMENTER, a word or two concerning their meaning may not be amiss.

Some of the titles more commonly met with are E.E., M.E., M.A., etc. To elucidate:

E.E. stands for Electrical Expert, but most always infers the rank of Electrical Engineer.

M.E. means Mechanical Engineer or Mining Engineer.

C.E.—Civil Engineer.

Cons. E.—Consulting Engineer.

Ch.E.—Chemical Engineer.

A.E.—Aeronautical Engineer.

R.E.—Radio (Wireless) Engineer, and in naval circles means Radio Electrician.

R.O.—Radio Operator.

T.E. refers to a Telephone Engineer.

S.E. refers to a Sanitary Engineer.

Another class including somewhat more academical degrees is embraced by the following:

B.Sc. infers a Bachelor of Science degree while B.S., though often used to imply the title just cited, really means a Bachelor of Surgery.

M.A. is a Master of Arts.

B.A. or A.B., a Bachelor of Arts.

Ph.D. is equivalent to Doctor of Philosophy.

Ph.B. acts as Bachelor of Philosophy.

D.Sc. and B.Sc., refer respectively to a Doctor and Bachelor of Science.

A professorship degree invariably involves several years post-graduate work, usually at teaching, and is denoted by prefixing to one's name the abbreviation:—Prof. When a person holds several scientific degrees, as a D.Sc. and Prof., it is usual, especially in Europe, to write them thus—Prof. Dr. John Smiley. Several other degrees and titles of everyday vintage are cited below: There is the degree; B. Sc. Arch., meaning a Bachelor of Science in Architecture.

B. or M. of Arch.—Bachelor or Master of Architecture, etc.

M.Sc.—relates to a Master of Science degree.

B.LL. or LL.B., is a Bachelor of Laws.

LL.D.—Doctor of Laws.

M.D.—Doctor of Medicine.
D.D.—Doctor of Divinity.
Ed.—Editor.
Assoc. Ed.—An Associate Editor.
Ass't. Ed.—Assistant Editor.
En'gr.—Engineer.

Members of learned societies use the following appendages:

American Institute of Electrical Engineers—Assoc. A.I.E.E. for associate member, or M.A.I.E.E. for members.

Institute of Radio Engineers—Assoc. I.R.E. or M.I.R.E. for associates and members respectively.

F.R.A.S.—Fellow of the Royal Astronomical Society.

F.R.G.S.—Fellow of the Royal Geographical Society.

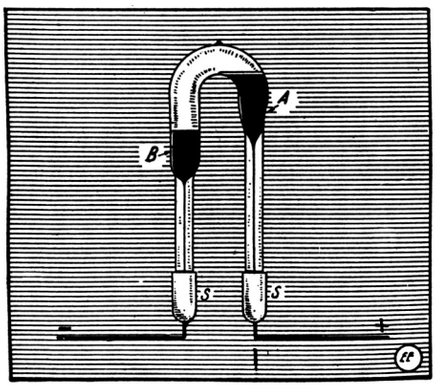
F.R.S.—Fellow of the Royal Society.

English Engineers who are members of the Institute of Electrical Engineers, London, use M.I.E.E. after their names. One of the world's most learned men was the late Silvanus P. Thompson of England. Such scholars as he often have a string of titles trailing off behind their name, beginning with A, and ending in the vicinity of Z. Many of the degrees or titles conferred, however, are honorary ones. Prof. Thompson signed, among other titles, those of D.Sc., B.A., F.R.A.S., F.R.S.

In some cases the college from which the degree was conferred is designated by stating the fact in brackets, thus: James Slocum, Ph.D., (Johns Hopkins University) or simply (Johns Hopkins).

A CADMIUM-VAPOR LAMP.

A new cadmium-vapor lamp has been described in the proceedings of the British



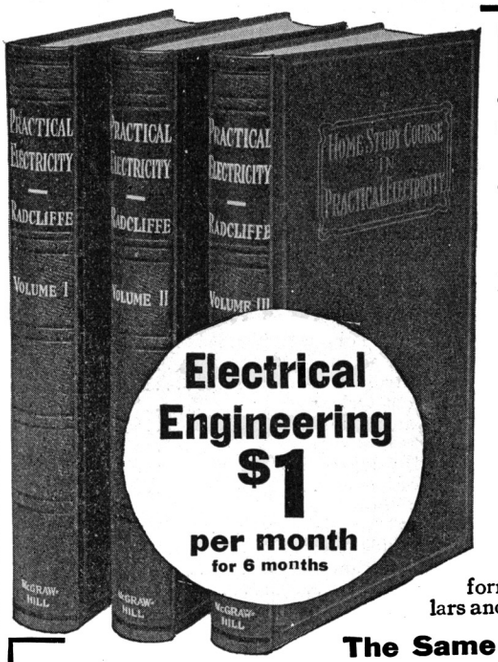
A New Cadmium-Vapor Lamp Suitable for Electric Circuits of 100 to 200 Volts Potential.

Physical Society. Although it is not yet past the experimental stage, the lamp is interesting at this time when so much work is being done on different types of illuminants.

This lamp is shaped like an inverted "U" with a long anode chamber and a short cathode chamber. The legs are thick-walled capillary tubes. When started the cadmium is volatilized by means of a Bunsen burner. A voltage of 100 to 200 is used with the lamp, while the current on short circuit is adjusted to 5 amperes by an external resistance. Ordinarily the potential across the terminals is about 30 volts.

AMERICAN INSTITUTE ACTIVE IN PREPAREDNESS PROPAGANDA.

John J. Carty, president of the American Institute of Electrical Engineers, has sent a letter to the membership calling for the co-operation of every member to the end that a careful industrial inventory of this country's manufacturing and producing resources for purposes of national defense may be made.



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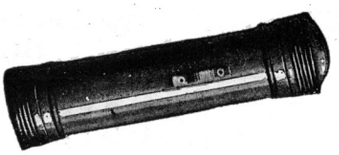

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In testimony before the state public utilities commission of Illinois in the matter of the proposed change of rates for electric service in Chicago there was introduced a statement of the minimum bills in effect in the cities of the United States having a population in excess of 250,000 people. The highest rate is at Buffalo and Baltimore where consumers are required to pay $1.20 a month irrespective of the fact whether they use any current or not. This list is as follows:

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St. Louis	50c per month
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LAST CALL

On November 1st, 1916, the subscription price of "The Electrical Experimenter" advances to $1.50 in U.S. (Canada $1.85, Foreign $2.00.) This is the last chance to subscribe at the old rates ($1.00 in U.S., Canada and Foreign $1.50). No subscription for more than five years at the old rate accepted. THE PUBLISHERS.

Jersey City	$1 per month
Cincinnati	$1 per month
Boston	$9 per annum
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Baltimore	$12 per annum

ELECTRICAL FOG DISSIPATION TO BE INVESTIGATED.

The Smithsonian Institute announces that it has made an appropriation to further experiments in the dissipation of fog by electricity, and that the investigations will be carried out under the general direction of Dr. F. G. Cottrell, who has already done much toward the practical precipitation of dust, smoke and chemical fumes in large industrial establishments. The idea of dispersing fog by electrical methods has been before the public for a number of years, though it appears never to have reached the stage of feasibility, on a commercial scale. The subject has recently aroused fresh attention, particularly in the neighborhood of San Francisco, through researches planned by the University of California in co-operation with the United States lighthouse service. The American Institute of Electrical Engineers has also appointed a committee to co-operate in this work. According to the Smithsonian report, the essential element to success seems to be some form of electrical apparatus of very high direct current voltage, with facilities for its control and ready application.

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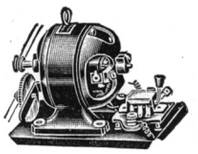

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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on. No attention given to unsigned communications.

Advice to Correspondents:

Before writing to these columns kindly bear the following in mind:

It is a comparatively easy matter for anyone to procure a patent. Anybody with a little mechanical and electrical ingenuity should find no difficulty in obtaining a patent and thousands of such useless "patents" are taken out every year.

The thoughts which should be uppermost in every inventor's and would-be inventor's mind are the following:

Is the idea practical?

Is there a demand for the device?

Does it fill an actual need?

Would you, yourself, if you had money, invest it in the exploitation of the idea?

Only after you have answered these questions to your full satisfaction should you begin working on the invention. There is no glory in getting a patent, and, as stated above, most anyone can obtain one.

Inventors can save themselves much hardship and much disappointment by bearing the above in mind.

This Department has been flooded with a great many useless ideas on which correspondents desired information and we hope the above statement will be borne in mind when writing to "Patent Advice."

NEW TYPE D. C. GENERATOR.

(93.) Earl W. Becker, Jamaica Plain, Mass., sends us description of a device which he has recently perfected. He would like to know if the device is patentable. He also desires to know if the machine is similar to that which was discussed in these columns in the March issue of THE ELECTRICAL EXPERIMENTER.

We are inclined to think that the machine in question would not give D.C. current. We are almost positive that the current would be A.C. We would advise our correspondent to get our book, "Dynamo Electrical Machines," sent prepaid for $1.50. This treats on the subject very extensively and many similar schemes are shown in this book. The idea in question is not at all similar to the one described by us before.

UNPATENTED INVENTION.

(94.) Geo. Brooks, Brooklyn, N.Y., writes as follows:

Will you kindly give me your opinion in these columns as to whether it is ever advisable to take up an invention with a manufacturer before the patent is allowed —that is, while the application is pending? I have been told that if such is done, in the case of unscrupulous manufacturers, it is always possible for them to force an interference with the hope of discouraging and freezing out the inventor. I would value your opinion on this subject.

You are quite correct in your statement. Cases where an unscrupulous manufacturer takes up an unpatented invention similar to the one you cite, are not at all uncommon. If you have not already obtained a patent, we would advise you to get one. The only other revenue left open would be to interview those manufacturers whom you know from experience to be worthy of your confidence. Quite a few ideas are sold in this manner to manufacturers of standing, and the preliminary agreement can be drawn up with them, which in many cases becomes binding, all, of course, depending on the nature of the invention, but the safest way in all cases is to take out a patent.

TELEPHONE PENCIL HOLDER.

(95) Merret Johnson, San Antonio, Texas, has sent in a sketch showing a pencil holder for a telephone and would like to have our opinion of same; if the idea is original, if a patent could be obtained upon it, etc.

(A) This is a fairly good idea, but without a paper pad we do not think it will amount to very much. In its present form we doubt very much if a patent could be obtained upon it. However, a small article of this kind might prove a successful manufacturing device, as it probably could be made to sell for 25c. or less.

OVERFLOW ALARM.

(96) Arthur Walsh, Montclair, New Jersey, wishes to be advised through the Patent Advice columns as to the practicability of an overflow alarm, sketches of which he has submitted to us. He also submits a sketch and description of an illuminated sign and desires advice on this also.

(A) We can find nothing new or original on these two devices, particularly the former. In this connection we would advise correspondents that there does not seem to exist a good market for overflow devices that attach either to ice box basins or to large water tanks. Nothing novel is shown in the illuminated sign.

PATENTS

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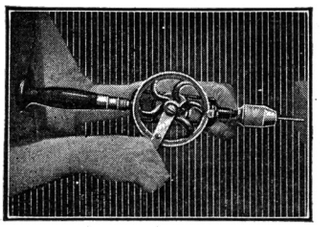

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SPEED PREVENTER.

(97) Vancil V. Roe, Minneapolis, Minnesota, has submitted an idea by means of which automobiles in large cities could be prevented from speeding—automatically—by installing a device inside of the car, which, as soon as the speed of the car becomes excessive, would cut off the power at once automatically. Our correspondent wishes to know what we think of the idea.

(A) The idea, as far as it goes, is an excellent one. There is, however, a big "But" connected with it. No automobile owner would, of his own accord, buy such a device for obvious reasons. It would necessitate the passing of laws in order to compel him to do so. Some localities would undoubtedly do so, but the inventor of the device would face an almost unsurmountable task to exploit such an invention and it is almost certain that not every city nor every state would pass such a law, upon which the entire practicability of the idea hinges.

SWITCH.

(98) E. F. Durbin, Orange, California, has submitted a design of a special single blade double pole switch which is quite ingenious. He wants to know what we think of it.

(A) While an excellent idea, we think that in practice such a switch would be too troublesome. Also, we do not think it would work quickly enough for general practice. Perhaps, by improving it, this objection might be overcome. The idea otherwise seems feasible.

WITH THE NOVEMBER ISSUE

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TELEVISION.

(99) Russell Quatermas, Marshfield, Oregon, would like to know if the device which he submits to us on television will work and whether a patent could be obtained upon it. He has imagined a screen, made up of many small particles of selenium with wires attached to each particle. This is the underlying idea.

(A) This scheme will not work. Simply by attaching wires to selenium particles will not cause them to be active selenium cells. Also, too many wires would have to be used, which makes the device at once impractical.

Ruhmer of Berlin had patented a device whereby he used a great many selenium cells which made up a large square. Geometric figures were thus transmitted at a distance. But in order to make a practical device of this kind for television, i.e., to see a person over a wire, the person to be moving at the same time, so many selenium cells would have to be used that the apparatus would cost above $1,000,000 to construct; and for that reason devices of this kind, employing selenium or selenium cells, have, so far, been unsuccessful.

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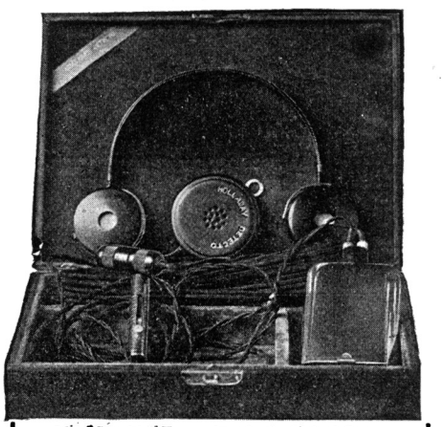

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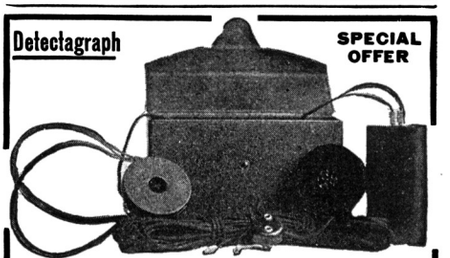

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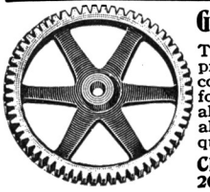

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THE ELECTRICAL VILLA OF A THOUSAND WONDERS.

(*Continued from page 390*)

was the genii who essayed the role of major-domo. Upon the large electric range there were a number of aluminum cooking utensils electrically heated. Miniature electric lamps were placed inside of the utensils, so that a piece of meat, for instance, could be inspected while being cooked. Extremely clever schemes had been worked out by M. Knap for performing a number of the usual culinary operations. One of the most interesting of these was a chicken broiler, which does not employ direct thermal heat but the reflected heat energy from a number of specially constructed powerful incandescent lamps. These lamps are suitably mounted in aluminum reflectors, while the heat rays are concentrated upon the chicken. And, moreover, when the fowl is properly broiled to the most toothsome point a bell rings and the Chef is notified that it is ready to serve. When it comes to boiling eggs, this is most quickly and expeditiously done by an automatic timing arrangement which will boil them for any given number of minutes. Mayonnaise sauce is made in a jiffy by an automatic, motor driven, stirring device which opens its own electrical circuit after a period of three minutes.

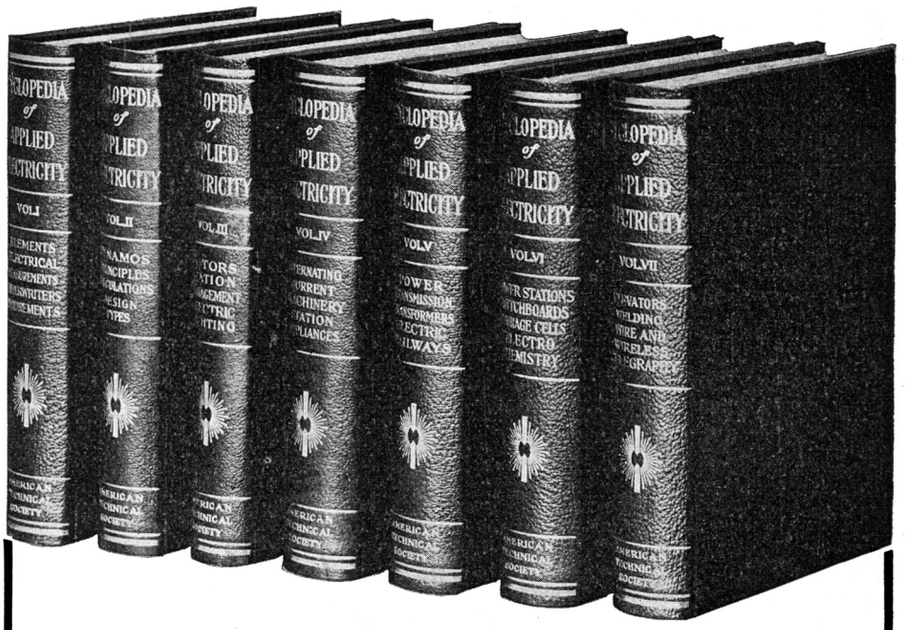
At one end of the Chef's domain there is a circular table containing a number of cooking apparatus so that one may sit in a chair at one point and simply revolve the table until the desired machine is before him, thus realizing a distinct saving in walking back and forth. This table contains, among other devices, an electrically operated meat hasher, butter churner, paste or dough mixer, and last, but not least, a small polishing and grinding machine for the cleaning of cutlery.

Each one of these apparatus is controlled by a separate switch mounted on the machine. After the meal has been served and the Chef and his assistants are deluged by a host of soiled dishes and cutlery, it becomes an easy matter to dispose of them as it is only necessary to put the dishes in an electrical dishwasher which, at the snap of a switch, is capable of thoroughly cleansing fifty china dinner plates in thirty seconds. Drying the dishes by hand is not necessary as they are sprayed with steaming hot water before leaving the dishwasher, and by the time they reach the outer air they are dry, due to the rapid evaporation of the moisture on them accelerated by dry, hot air blasts.

Before leaving the Chef's quarters the manner of sending up the various dishes, etc., to the table and dining-room above was demonstrated. A lever marked "Up" was simply pressed to quickly dispatch the dish ceilingward to the dining table, and in like manner a lever labeled "Down" brought the dishes down to the serving table in the kitchen.

We proceeded to visit other parts of the mansion and I was shown how music could be heard in every room by means of a loud-speaking telephone neatly ensconced in the walls, and also how conversation in any room could be transmitted by means of Dictaphones hidden in the walls and heard by the host in his bed chamber. Thus, apparently, it would be extremely difficult for the servants to hatch any conspiracy overnight.

In the front hall we saw the controlling switches for the motor operated gate at the entrance to the grounds and also a loud-speaking telephone through which the voice spoke to me as I stood at the portals. Also thermostats were observed on the ceilings in various parts of the house, which I was told, operated fire alarm bells to awaken the guests in event of a conflagration. M. Knap then showed me a Voice-Scriber and let me talk into it, whereupon the machine



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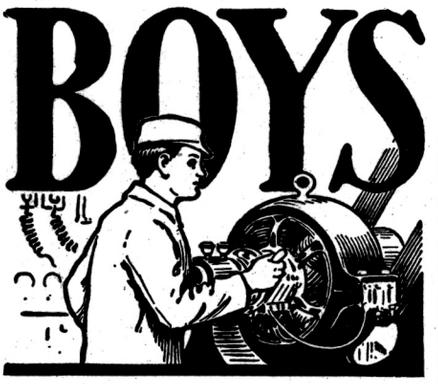

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wrote off the spoken words. This he explained was in the experimental stage as yet.

I had been so engrossed in the marvels of this wonderful mansion that I was much surprised when I observed that night was drawing near. Monsieur Knap courteously requested me to spend that evening with him, and I was more than pleased to avail myself of such an opportunity.

We adjourned to the reception room and my host suggested a game of billiards to speed the evening hours along. But as in my tour through the house I had observed not a trace of a billiard table, I was certainly at a loss as to how we would be able to play. But no sooner had this thought flashed through my mind than my host, as if to anticipate me, pressed a button and a regular life-size billiard table rose from the floor. An innocent looking panel had covered the table previously.

When the hour for retiring approached mine host bade me *bon soir* and wished me pleasant dreams. I found my sleeping chamber a marvel of convenience and in planning this apartment it was made evident to me that no necessary convenience had been overlooked. I found that by turning a button on a switchboard conveniently located beside the bed, the window curtains could be closed and opened. And, wonder of wonders, an instantaneous electric water heater presented itself for my convenience. As is well known, hot water spigot service is an unknown quantity in most French houses and a bathroom is a rare luxury indeed. Before retiring I discovered that the windows could be closed or opened at my desire by simply turning a switch which controlled an electric motor. Also there were electrically heated hot water bottles for those having cold feet.

I arose in the morning with the sun streaming through the windows and recalling that I had but to push a button to draw the curtains together, I at once availed myself of this service. A telephone placed conveniently beside the bed enabled me to communicate with the Chef and order some breakfast. In a few moments my *déjeuner* had arrived on an automatic electric elevator beside the bed, similar to the one in the main dining-room. After this refreshing meal I proceeded to dress and found M. Knap in the reception room busily engaged in reading the morning papers.

Before bidding him farewell, however, he asked me to step into his electrical conservatory, where he grew several of the choicest fruits in a very short period of time, and all because he simply bathed them in an electric light during the night, so that they proceeded to grow all the time.

And as I bid him adieu he pinned to my coat lapel a boutonniere of electrically grown carnations.

WHEN THE ENGINEERS GO TO WAR.

(*Continued from page 391*)

Besides the excellent training given at West Point, and also at Annapolis, the U.S. Government conducts an *engineers' school* at Washington Barracks, Washington, D.C. This school is under the control of the chief of engineers. Its object is to prepare junior officers of engineers for active duties of their corps, to make experiments and recommendations and to give instructions pertaining to civil engineering work of the Army course of instructions, covering a period of 13 months, beginning September 1st and ending September 30th of the following year. Diplomas are given to students who successfully complete the course.

In time of war the engineering squad collectively and individually forms one of the most important units of the regular army for all sorts of defenses, from that of mining a river or harbor to the construction of a massive concrete redoubt or fortification. Contrary to general opinion it is not always the luck of these highly trained men to be back beyond the firing line, and some of the work includes such hazardous propositions as the rebuilding of bridges or complete Pontoon bridges under fire, as witnessed in many of the pictures which have arrived from the German army battle lines in the present war. Also the destruction of buildings and bridges raked by rifle or artillery fire and the construction of telephone and telegraph lines, which are often under gun fire, besides many other details of military work, such as surveying various building operations, trenches, big gun mountings and railroad track layouts.

The illustrations shown herewith bring out some of the unusual points of military engineering. The first view shows two German engineers placing a mine under a concrete bridge, under the direction of a superior officer. Possibly within a few moments' time this bridge will be no more. The engineers will leave the bridge and at the touch of an electric button this mighty structure of stone and cement will rise like a thing alive for a moment—then collapse into a shapeless heap of ruins. Some of the bridges dynamited by the demolition squad in order to check the advance of the enemy have been half a mile or more in length. Several of the finest bridges in Europe have been thus destroyed, for tactical purposes.

The electrical features, which, of course, include the radio telegraph in modern military manoeuvres, either in time of peace or war, are quite colossal by themselves. Wonderfully powerful electric searchlights sweep over the sky at night in search of the enemy's aeroplanes or Zeppelins, while on the other hand several thousand volts of deadly current may be passing through the barbed wire fences, separating the fighting factions. The soldier on touching such a fence is often electrocuted. Electricity plays a very important rôle in the ignition of the explosives, particularly those used for mining or dynamiting any structure which must be blown up. A small electric battery or dynamo furnishes the current for these operations, and at the touch of the button the electric current passes with the speed of lightning over the fine copper wires, which terminate in a cap or igniter, which fires the dynamite or high explosive charge.

When the army retreats it is often found by the advancing enemy that his foe has prepared a very warm reception for him in the shape of a thoroughly mined and electrically wired field. In some cases these mines are connected up with electric wires placed 1,000 feet or more away, so that the retiring troops can wait until their adversary has advanced on to this area, when, at the push of a button, the ground, troops, cannons and everything are hurled skyward.

The various units of a large army are kept in constant touch with the general in command and all officers of the general staff by telephone, telegraph and wireless. The signal corps take care of most of the signaling installations, such as those just mentioned and the portable wireless outfits now used by the army and navy can be unpacked and set up ready for instant use in a few minutes' time after their arrival upon the spot.

The engineer, or those who have a hankering for the military phases of engineering, will find that a vast amount of interesting work awaits them. There is always a plentiful number of new problems awaiting solution, particularly those covering electrical branches of the art, aside from those of gunnery, range finding, sanitation, transportation, and the building of fortifications.

A TRIP THRU A MODERN RESEARCH LABORATORY.

(*Continued from page 394*)

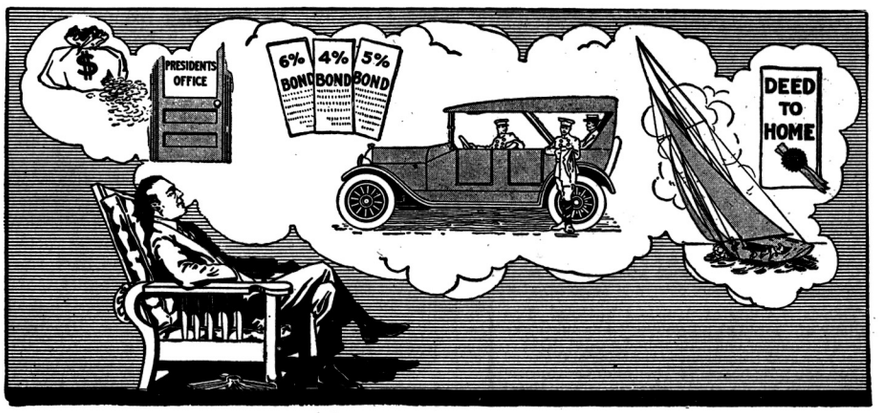
head of the department as to the manner in which the tests are to be conducted. Each transmitter is connected with its respective receiver in a different room, which is also under one man's control. The operator in the transmitter room continuously speaks in a uniform tone to his group of instruments, thus performing the same duty as if they were in actual service. A large number of operators are employed exclusively for testing these instruments; by these tests the operating characteristics of the different parts of the transmitters are determined. The work is conducted by a number of transmission engineers; several phonographs are also used as sound generators. The transmitter under test is placed over the reproducing head of the machine and the head is automatically released when it reaches the end of the record, and brought back to the beginning. This operation is performed continuously. The instrument is enclosed in a sound proof cabinet so that the sounds produced will not interfere with the operators around the machines.

The selective party line ringing testing laboratory was next visited. In this room every conceivable ringing device is put under a severe test. A part of this laboratory is illustrated in Fig. 2. The numerous wires on the wall are connected to various ringing instruments, stationed about the room and currents of various frequencies are supplied by generators located in the dynamo room. The oscillograph on the table in the background is used for determining the operating characteristics of the instrument when tested with currents of different frequencies. The bank of bells above the oscillograph are under test. The switchboard on the right is used for controlling the different forms of currents supplied to this laboratory.

We passed on to the incandescent lamp room, where the miniature electric lamps, used on telephone switchboards, are tested. The lamp panel is shown in Fig. 3. The various jack plugs on the switchboard are used to supply current of any voltage to any one of the racks, each of which contains a large number of spring contacts, in which the lamps are held, and also serve the purpose of connecting the filament to the current supply. Every one of these lamps is put under a life test so as to determine the number of hours each lamp will last under normal operating conditions and each rack is operated with a different voltage. The ammeter on top of the switchboard indicates the number of amperes that the rack consumes. The two metallic covers above the racks are used for conveying away the heat developed by the large number of lamps under test.

Various instruments developed by the company are put under a wearing-life test. The laboratory which cares for this work is seen at Fig. 4. The machines in the foreground are testing a number of switches under accurate service conditions. Each cam operates one switch. The machine on the center of the table controls a number of side operating lever switches. Each testing machine is fitted with a counting instrument, so that the number of times that the switch is operated and released is accurately known.

Incredible though it may sound, thousands and thousands of dollars have been expended on the development and perfecting of the little green flexible cord used on the telephone receiver. This cord is made up entirely of fine metal strands of tinsel wound around a cotton thread, then twisted into a bundle to serve as a conductor for the electric current. Every time the tele-



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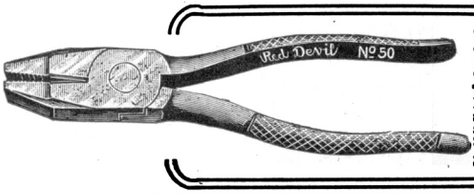

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phone receiver is removed from the hook the cord is bent, and each bending brings nearer the time when one or more of the tinsel filaments will break. As these filaments break, a fine cracking sound is produced in the receiver, which interrupts the clearness of the conversation that is going on over the wire, an annoyance to the user of the telephone which forces him to discontinue the use of the apparatus, which necessarily means a loss to the operating company. This was a great nuisance in the olden times due to the imperfect tinsel conductors used. Therefore development work has been carried on in the laboratories in order to perfect the qualities of the fine metal tinsels used in that little green cord as well as the cords used for switch board work. Life tests are also conducted on these flexible conductors.

Did you ever notice the finish on the metal stand of your desk telephone? Well, that particular detail has worried some of the best telephone engineers. Considerable time and money was spent a few years ago to build a special set of apparatus, with which it was proposed to bake on an especially tough, wear-resisting coating on desk stands. Some persons' perspiration would attack certain finishes and so it came to pass that this one finish, which was in the process of development, never lived to meet the telephone-using public. Many other similar examples could be cited which would total up a king's ransom, and no small one at that.

This description gives the telephone user something to think of when he puts five cents in the slot of a pay station. How many nickels must be spent, even daily, to support these laboratories with their expensive equipment and highly paid employees?

THE FEMININE WIRELESS AMATEUR.

(*Continued from page 397*)

tion of new posts will be carried on rapidly, as many applications for membership in such posts in various cities have been received. The girls' division of the Naval Reserve has been formed not for a handful of girls whose parents can easily afford to pay for a few weeks' training in a camp, but to reach out to girls who need the training and discipline which the reserve assures them but are unable to pay for such training. Funds to help them in the work prescribed are needed.

There are many girls who are desirous of such training to make them better citizens, who are inspired with patriotism that is just as keen and unselfish as the patriotism that sends the young men and youths of the land into the militia, the regular Army or the Navy. With the training which the Naval Reserve will give them these girls will be fitted for hospital attendants, Red Cross nurses, operators of wireless telegraphy and many other positions in case of need.

The training of the girls who volunteer for work will not be altogether with a view to service to their country in the time of war, but in the time of peace as well.

The science of wireless telegraphy is one of the newest and at the same time one of the deepest subjects extant. The practical ideas have been worked out, it is true, so that an operator can simply close a switch and proceed to manipulate the key, but there are a thousand and one problems of every variety imaginable to be investigated and solved before radio will become anything like an *exact* science.

Primarily speaking, radio operating requires more than a knowledge of how to "punch" a telegraph key, differing greatly in this respect from wire telegraphy. The schools teaching radio have worked out the problem of imparting the necessary training in a very reasonable time, however, varying from a few months up to a year. The training period depends, of course, upon the knowledge possessed by the student when he or she enters the school.

Basically, of course, the predominant idea is to thoroughly inculcate upon the student's mind the method of handling the transmitting key, which resembles a regular Morse telegraph key exactly. The signals are heard in the telephone receivers, strapped to the head, in the form of short and long buzzing noises. There is no *back kick* sound as in wire telegraphy, which arises from the *sounder* arm falling back against its stop.

Besides the usual message form lessons, radiogram make-up, abbreviations, etc., there are the highly interesting and necessary studies of how the waves travel through the ether; electromagnetic induction, dynamos and motors; storage batteries; tuning of the apparatus to different wave lengths so as to eliminate interference from other stations; procedure in case the dynamo current fails; et cetera. It takes a good head for all these studies and so it becomes self-evident that it is a very honorable accomplishment to have graduated as a first-class radio operator.

Again, this is not the end and all of the proposition at all. We have before us the great and as yet, but little explored field of *radio engineering*. Women seem to progress excellently in the engineering branches. Primarily this is so because her brain is quick of action, and moreover she usually will be found to have extremely well-balanced ideas as to proportions, so essential in designing. A wonderful imagination coupled to a number of other worthy faculties help to make a really fine combination, so that we find a steadily growing number of women architects, mechanical and electrical experts, radio operators, civil engineers, *ad lib.* What we need is more of them in the higher positions, where the square root and binomial theorem are everyday quantities.

HOW THE FARMER USES ELECTRICITY.

(*Continued from page 399*)

tural electric supply schemes. In the United States, California used more power per head of population than any other American state. Canada, Australia, New Zealand, Italy, Austria, Switzerland, Denmark and Holland also have important examples of electrical installation system and service for agriculture. Mr. Kerr based his advice and the conclusions which he put before the convention of the municipal Electrical Association upon some years' experience in farm supply work in his own neighborhood, Hereford. He holds that there is an enormous business of a similar kind awaiting development in England. In Hereford district a system of light transmission lines has been erected to reach agricultural consumers.

To prevent cattle from rubbing against the poles they are placed close into the hedges.

In an average case, stated this engineer, a 10-horsepower motor will meet all the requirements of a farm except for threshing and cider milling, but motors up to 20 horsepower have been hired out for these purposes, which are only seasonable jobs and do not require a permanent fixing.

He gave descriptive information concerning a dairy installation which included a vacuum pump for the milking machinery. This machine requires 1.5 horsepower and is used twice daily for two hours in the morning and 1.25 hours in the afternoon. The cows milked average about 70, and the machinery capacity is for 88. The

farm bailiff states that it would require five men at least, who are expert milkers, to do the work in the same time, or with his present staff five or six hours a day longer. In regard to root-pulping and chaff-cutting, experience shows that owing to the easy starting of an electric motor the exact quantity of food can be cut and mixed fresh as required, a very important result being a greater yield of cream in the milk.

There were as a rule five farms to the mile along an average road, and many ordinary country residences. An average revenue of at least $500 per annum would be yielded from the five farms and between $100 and $1,000 from the private houses, as there were large country residences which were only too anxious to have such a permanent source of supply, paying twelve cents per unit for it. Mr. Kerr said that existing data showed that the average consumption of current in an agricultural district with a population of 22,500 was 58 kilowatt-hours per head, and for the population of the county of Hereford (114,296) he estimated a possible sale of 6,637,000 units; that is in an area of 40 miles long by 35 miles wide, with a central distributing point.

The tiller of the soil is becoming more of a scientist every day, with electrical schemes for performing not only his ordinary "chores," but such philosophical desideratums as "ridding the earth of insects and their larvae electrically" as described in the August, 1916, number of THE ELECTRICAL EXPERIMENTER, on up to the subject of "Electric Horticulture." Papers on the latter and many other vital subjects can be procured from the Superintendent of Documents, Washington, D.C., also from the Department of Agriculture, Washington, D.C.

ELECTRICAL FRAUDS.

(*Continued from page 392*)

the American backwoods or in darkest Russia. It was advertised in full page advertisements in the largest and most respectable German weeklies for several years, right up to the outbreak of the present war. Wonderful photographs showed "before using it and after" effects The pictures were most impressive, as well as wonderful, and many "physicians" lent their names to praising the marvelous power of the "grower."

An inspection revealed the fact that the handle contained a single dry cell giving one and a half volts and about two amperes *while new.* This constituted the full electric equipment. The current went through the handle into your hand and from there through the body and through the head into the metallic ball-pointed bristles, thence back to the battery. When the scalp was wet there is no doubt that a very anaemic current dragged itself through the hair roots of the scalp, but we refuse to believe that a one and a half volt current flowing through the high resistance of the human body can sufficiently stimulate dead or weakened hair-papillae to make even a passing impression. A fraud pure and simple and as clever as it is simple. Some of these elaborate outfits with "attachments" and all sorts of refinements sold as high as twenty-five dollars for the set. And that in enlightened Germany!

Preposterous as the above device is, the magnetic hair brush and the magnetic hair comb, illustrated in figures 6 and 7, go it one better. Of course they are, or rather *were,* made in America, till Uncle Sam, through his Postoffice Department, closed up the thriving manufacturer for defrauding the public through the mails. Hundreds of thousands of these appliances were sold at one time, and it is safe to say that thousands of them are still in use this minute.

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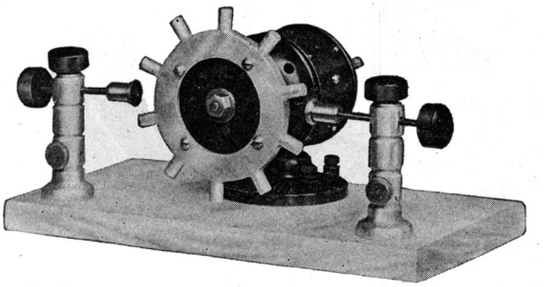

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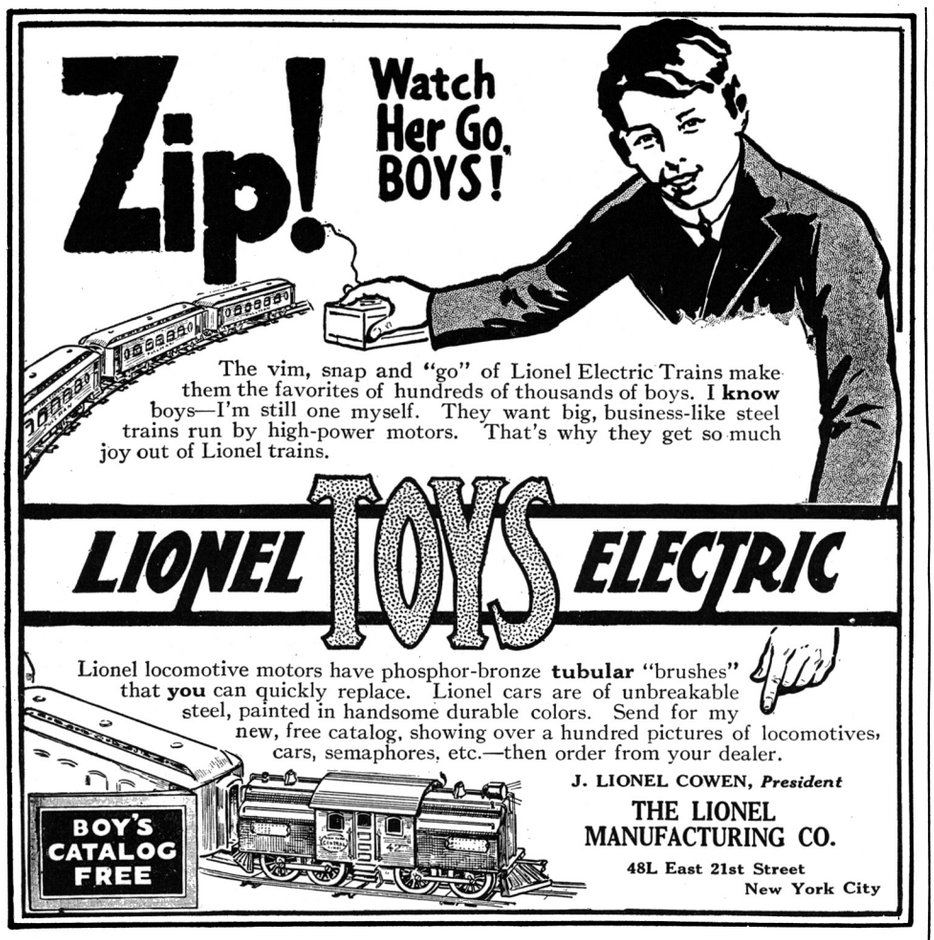

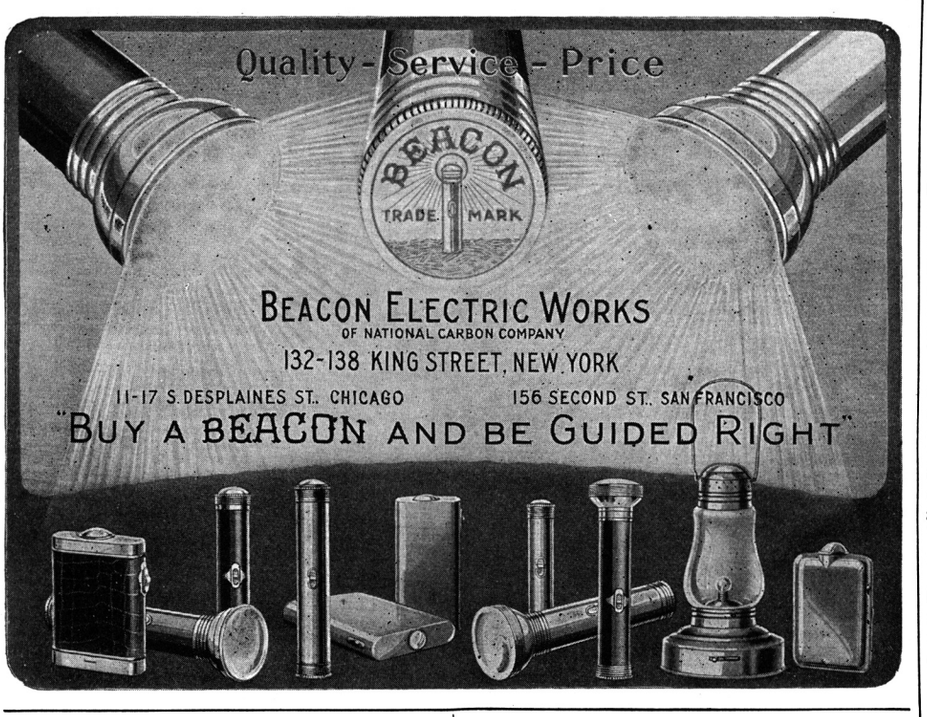

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The "electric" brushes sold from $1 to $3 and were good hair brushes as brushes go, but that was all. There was no pretense made of a battery being supplied, though the name would lead you to believe so. Under the cover there was a mediocre permanent steel magnet. That was all! And to prove to you how "strong" this brush was, the makers supplied a little compass with it! Bringing the brush near the compass, the needle would be agitated of course and the layman thought this was a sure test of the marvelous inherent curative power of the brush.

Powerful electro-magnets, capable of lifting tons, have been used in experimenting upon humans and animals and a famous French institution, after several years of study, has announced that magnetism, no matter how strong or how weak, has not the slightest effect whatsoever upon the human body, its nerves or the senses.

Notwithstanding this the "electric" hair brush makers in their literature claim the following for their brush:

They will positively CURE nervous headache in five minutes; bilious headache in five minutes; neuralgia in five minutes; falling hair and baldness; dandruff and diseases of the scalp! Promptly arrest premature grayness. Make the hair grow long and glossy. Immediately soothe weary brain. They have won their way to royal favor in England, being cordially endorsed by the Prince and Princess of Wales, used by the King of Holland and Prince Bismarck, and written upon by the Rt. Hon. W. E. Gladstone. They cure by natural means; will always do good, never harm, and are a remedy lasting for many years. They should be used daily in place of the ordinary hair brush, hair washes or hair growers.

And let no one think that the bristles were of steel or iron to "conduct" the magnetism to the hair-roots. Indeed not, ordinary bristles were used!

The "electric" comb as shown in figure 7 belongs to the same class as the brush just described. A permanent magnet was vulcanized into its back. That was all. Its curative power was claimed to be almost as high as that of the brush!

Then there was the "electric" tooth brush, figure 7, having a metallic handle with the bristles set into the metal. This clever device sold readily and as with "electric" belts it really does produce a weak current for a few seconds. Here the current enters the hand by the handle, from where it flows through the body and moist tongue as well as moist lips, back to the brush. The electricity in this case was claimed to produce "sound, white teeth and rosy gums"!

Figure 7 also portrays the magnetic finger ring as well as the "electric" finger ring. Of these hundreds of thousands have been sold and are still being sold in this country. The price of the rings varies from twenty-five cents to one dollar apiece! The magnetic ring is a plain steel band shaped like an ordinary ring; it is of course magnetized. When worn steady it cures anything from acute rheumatism down to snake bites!

While the magnetic ring at least owns a bit of real magnetism, its brother, the "electric" ring, is as dead as a doornail, even when "worn steadily." It is a thick band of copper, while in its inside a second ring of zinc is let in; see figure 7. The zinc is flush with the copper, as will be observed. No pretense is made to insulate the copper from the zinc, consequently the two metals are thoroughly short circuited in an efficient manner. Such a contrivance can of course not even produce a momentary current as does the "electric" belt, while the perspiration of the finger naturally short circuits the two metals still further, if that were possible. The action therefore is nil, as far as electricity is concerned.

The magnetic razor, figure 8, is another offender and though very few makers advertise great claims for its "power," still a host of laymen are misled, as they think that such a razor has certain wonderful properties. Healing or curing powers are now seldom claimed by the makers, but the salesman selling it over the counter, not infrequently uses very fancy "scientific" selling talk. Their claims run from "smoother shaving," "keener edge" down to "prevention of barber's itch," etc., claims which were never dreamed of by the makers.

We have already stated that magnetism has absolutely no effect on the human body, either positive or negative and a magnetic razor certainly does not change this fact. As a matter of fact, the writer, for one, rather shaves with a non-magnetic razor. This is the reason: Some years ago we had occasion to view a non-magnetized as well as a magnetized razor under a powerful microscope. The former showed a clean ragged edge with clean "teeth," as does any good razor. The magnetic razor, on the other hand, had minute steel particles clinging to the teeth, held there by magnetism. Continuous stropping did not improve the condition; some particles no doubt stuck to the stropper, but new ones, torn off from the razor's edge took their places. It was the writer's belief that such fine steel particles might find their way into an open cut and while this might not be very dangerous, there is no necessity for inviting unnecessary trouble.

One of the most curious "electric" frauds that ever came to our attention was sent to the writer by a Texas prospector some years ago. This "ore finder," figure 9, was marketed by a Pennsylvania concern and the contrivance sold for fifty dollars. Its manufacturing cost is perhaps four dollars.

The apparatus is nothing but an ordinary nickel-plated buzzer mounted on a nickel-plated tube, which contains a common tubular flash light battery. An adjusting screw is mounted on a bracket which is supported at the bottom by a spring. It is evident that if any pressure is exerted on the spring at the bottom, contact will be made and the buzzer will operate. Just how this contact is brought about we are as yet ignorant, but we presume that the "Mineral Magnet" performs this function!!

This "mineral magnet" is supposed to start in jerking the string as soon as it comes near a lost treasure, presumably out of sheer excitement. It will also act in the same manner for other minerals.

This is what the makers say about it: "The reason our instruments are the best and most sensitive is that the *mineral magnets* are composed of the latest discovered and deepest earth penetrating magnetic composition known to electricians and mineralogy science. We guarantee our instruments to be the best and most perfect instruments ever invented for prospectors seeking mines and hidden treasures. All our mineral magnets are made on a scientific basis, they are hollow, filled, charged and sealed with each affinity, (? !!) Electro Magnet mineral which produces the proper attraction for locating any of the above named minerals.

"To make location without instruments the prospector takes hold of the electric light battery magazine with both hands as described in illustration, holding it directly in front of him and as level as possible, following in the direction in which the mineral magnet leads, and as soon as the deposit is reached the magnet will have a downward attraction, which will cause the electric buzzer to make a continuous noise, incidentally showing the exact location.

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condition of the soil and the richness of the deposit."

The concern furthermore states that the price of the "ore finder" is $50.00 cash, but in the same breath it goes on and says that it will let any prospector have the meter for $15.00 with the understanding that he will pay $50.00 every time he makes a successful paying location!!

That any one person in his right senses should buy such a contrivance is beyond our understanding. It does not seem to enter these poor prospectors' heads that if the thing really worked the man who made it would go prospecting himself.

However, as long as the people want to be fooled and are willing to pay for it, we presume we have no right to complain.

MARVELS OF MODERN PHYSICS.

(*Continued from page 407*)

Low temperature phenomena have a very direct bearing on the theory of electrical conductivity, magnetism, specific heats, and in general, the whole theory of the constitution of matter. In nearly all metals, the electrical resistance decreases with the temperature, and Onnes found that *near the absolute zero the resistance practically vanished altogether.* The behavior of mercury for instance is remarkable, and is shown in the graph Fig. 1. The resistance is plotted as a ratio, that is, its value at any temperature is divided by its value at 0 deg. Cent., but this does not affect the quality of the curve. The resistance of the mercury decreases regularly until at about 4 degrees above absolute zero it suddenly falls to about a millionth of its original value, or approximately zero. At this point it becomes almost a perfect conductor. Tin and lead show the same effect, and Onnes using a coil of lead wire immersed in liquefied helium, introduced a current of electricity into the coil and short-circuited it. Due to the boosting effect of inductance and the negligible resistance he found the current had not decreased noticeably after two hours. At such a point, the voltage might be an extremely small fraction and still the current would be thousands of amperes. Think what this might mean in practical work, if the resistance of a power circuit could be reduced to a millionth of its usual value! The power available would then be as great as from a million such circuits.

Under the electron theory, the dying out of the kinetic energy of the molecule and its inter-atomic forces and movements, seems to remove any resistance to the motion of the electrons in a current.

Curie derived the law that the paramagnetic susceptibility of a substance is inversely proportional to the absolute temperature, but it had been found that near absolute zero the law does not hold good. It has also been ascertained that specific heats change irregularly at low temperatures, and a careful study of these facts and the facts of conduction show a continual relationship, and one which points to a simple connection between them all. The absolute zero is no doubt an unattainable limit, and also a barrier behind which are hidden many of the secrets of physical phenomena.

No mention has been made so far of the different temperature scales, and the method of measuring very low temperatures. The Centigrade is the scientific scale in common use, while quite often the *absolute* scale is used. A comparison of these and of the common Fahrenheit scale will be found in Fig. 2. The zero of the Fahrenheit scale was taken at 32 degrees below freezing, at what was then thought to be the lowest possible temperature. The Centigrade scale aimed at a more rational size of unit, and Celsius, its inventor, took freezing water as zero, boiling water as one hundred, and divided the intervening space into one hundred degrees of equal size. The *absolute* scale as seen begins at absolute zero, using the unit of Celsius, and measures all temperatures in positive terms or in degrees above zero. The absolute temperature can be obtained easily by algebraically adding the Centigrade reading to 273.

The fact that both mercury and alcohol freeze at medium low temperatures makes it impossible for them to be used in extremely low measurements. In their stead a gas thermometer is always used, assuming that the gas in the thermometer follows the law of a perfect gas. It is thought that any possible error is exceedingly small. The typical kind is shown in Fig. 3. The bulb B is first filled with a gas, usually hydrogen; then mercury is introduced into the tube leaving a vacuum above the column at V. Cooling or heating the bulb B will cause the gas to expand or contract and force the mercury down at H or draw it up, but the level of the mercury can always be returned to H, thereby keeping the volume of the gas constant by simply raising or lowering the other arm of the tube V. As is well known, the pressure of a gas varies directly as the absolute temperature of the volume is kept constant; therefore the pressure necessary to keep the volume constant is a measure of the temperature. It is easily seen that the pressure at H depends on the height of the mercury column in V above H, hence we find the scale on H measures this height in terms of degrees.

If the level in V and H were the same, that is if no pressure was being exerted, the pressure of the gas would also be zero, and as we already know the temperature would also be zero; but as the mercury in V can sink no lower than in H, that is the point of lowest possible temperature.

All study of heat brings us finally to the questions of its origin and meaning. Lord Kelvin says that our great source of heat—the Sun—will not continue to radiate enough heat to support life on the earth for more than a few million years at most. If so, what will happen then? The fact that heat and electricity in their radiant forms are one and the same, shows how fundamental each is and how closely related. The field of Heat is not a narrow one, but only another gateway to the entire field of Physics.

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Teacher—Well, isn't that plain enough? Did you never see it before?

Sammy—Yes'm, yes'm, but I always thought that was his telephone number.

RADIO LEAGUE OF AMERICA.

(*Continued from page 409*)

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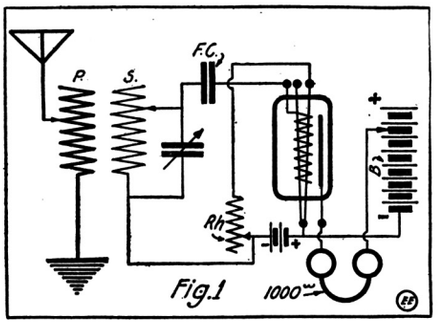

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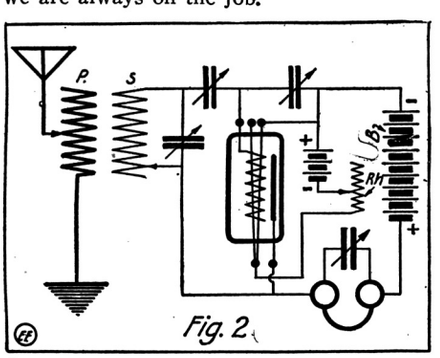

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(Addition to list published in July issue.)

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Monroe Radio Association, Monroe City, Mo. Secretary, Harry E. Longmire, Monroe City, Mo.

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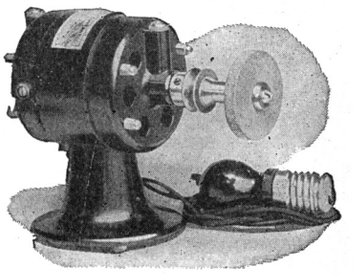

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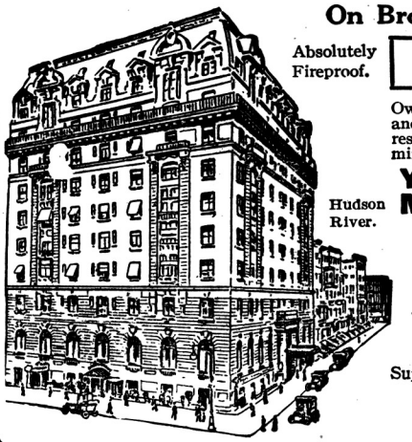

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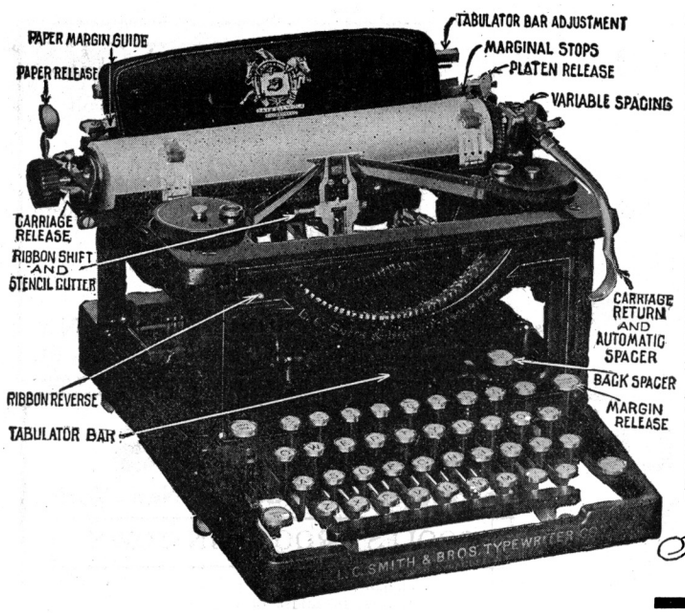

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ELECTRICITY NOW PARES ALLIES' VEGETABLES.

The tons and tons of vegetables required for canned stew to feed the fighting forces of the allies now in the trenches *Somewhere in France* will not be touched by a human hand. They will be pared electrically.

A Canadian company which has recently received a contract for millions of cans of a desiccated compote, or stew, composed of six vegetables, for consumption by the allied armies has purchased a large number of electrically-operated vegetable-paring machines manufactured in this country.

The American blue jacket will also be fed with sanitary pared vegetables, a contract for a number of these machines for use in the American navy having recently been made by the United States government.

Nearly 3,000,000 dollars' worth of electrical apparatus was exported in February, 1916.

SOME INTERESTING NEW RADIO APPARATUS.

(*Continued from page 410*)

in the background. A fixed condenser is shunted across the terminals in order to prevent sparking and thus save the platinum tips. Not only can this instrument be used as a buzzer test but it can be used as a buzzer transmitter. Different frequencies can be obtained with the instruments providing a different tuning fork is used. If several of them are employed and each emits a different tone, an electric "piano" can thus be made. It is suitable for testing purposes and as an exciter for wave meters.

A very clever radio transmitting key has been recently put on the market which is shown in Fig. 5. The lever is held between two rectangular brass blocks by a pin, with contacts placed on the side of the arm as indicated. These are made with flanges so as to permit the sparking surface of the contacts to be cooled. It has been found that a greater amount of current can be handled with this key than with the ordinary radio type as used heretofore. The reason for this is that larger contacts can be put on this key than the other standards; the explanation is self-evident from the illustration of the key.

A variable condenser which gives a linear or straight line calibration curve is illustrated at Fig. 6. The rotary plates are so constructed that practically zero capacity is obtained; this is done by rounding the edges of each of the plates, as can be seen. They are specially mounted so as to obtain perfect balance throughout the complete rotation of 360 degrees. A rotary dial is provided on the movable plates, and a stationary indicator secured to the cover. This condenser is very suitable for all kinds of measurement work and especially for a wave meter capacity.

An audibility meter which measures the intensity of signals heard on the receiving instruments is shown in Fig. 7. This, like other audibility instruments, operates on the comparison method; that is, a resistance is shunted across the phones, so that the incoming wave is reduced until it is barely heard in the receiver. When this is obtained the audibility of the signal is found by noting the amount of resistance added to the line in order to overbalance the incoming signal. Thus a greater amount of resistance will be necessary to reduce a strong signal than a weak one. This meter is already calibrated and the audibility factors are marked on each of the contacts. Connecting it up with the receiving instruments and rotating the switch lever until the sound in the telephone receivers just vanishes and noting the indication of the contact upon which the lever rests, gives the audibility of the incoming signals. This instrument is extremely valuable in determining the effect of different weather conditions upon radio communication.

The description of the above instruments will undoubtedly prove beneficial to the great army of radio experimenters who are constantly looking for something new in designs for radio instruments.

REMARKABLE TRIP BY ELECTRIC AUTO.

A trip by electric atuomobile from Boston to Portland, Me., and return was made recently by Mr. Rogers of the Anderson Electric Car Company and Mr. Kelley, manager of the New England branch of the Philadelphia Storage Battery Company. The run to Portland was made in 7.25 hours, and the return trip in 7 hours, the distance being 129 miles, owing to a detour of several miles. The car was a Detroit electric, taken from stock, and was equipped with Philadelphia thinplate storage batteries.

RADIO TELEPHONY ON THE MEXICAN FRONT.

(*Continued from page 411*)

ployed with this outfit is of the Audion type as the reader will observe on the side of the receiving cabinet. The bulb is protected from outside blows by a semi-circular wire guard. This permits the set to be carried about without danger of injuring the detector. The current for the filament is obtained from storage cells. These are seen standing on the ground.

The aerial mast, of steel tubing, stands behind the outfit, and it takes but a few minutes to erect it, ready for work. The output of this particular outfit is 1 k.w., sufficient to transmit 100 to 150 miles, which is high indeed considering the climatic and topographical conditions found in Mexico.

SAXONY CONTROLS ALL ELECTRICITY.

The government of Saxony has decided to take over complete control of the generation and distribution of electricity in the state. Coal fields and one big generating station already have been acquired and the Saxon Landtag has just voted several million dollars for further outlays. Eventually it is expected that the whole electrical supply in the kingdom will be taken from the state system so that the government will be able to fix the lowest possible charges. At the same time the government has no intention of preventing local public bodies or private corporations and individuals from producing their own electrical power.

As a beginning, the government has purchased for a million and a quarter dollars, the steam generating station at Hirschfelde on the river Neisse, belonging to a Berlin company. This station has already a capacity of 25,500 kilowatts and the plant is quite new. Moreover it is close to one of the coal fields bought bv the state. Later the government will erect new works near the western coal fields, where there are already stations with which negotiations are now going on to arrange the necessary cöoperation.

A new department of the government to be called the "Direction of the State Electricity Works" will be established to manage the scheme.

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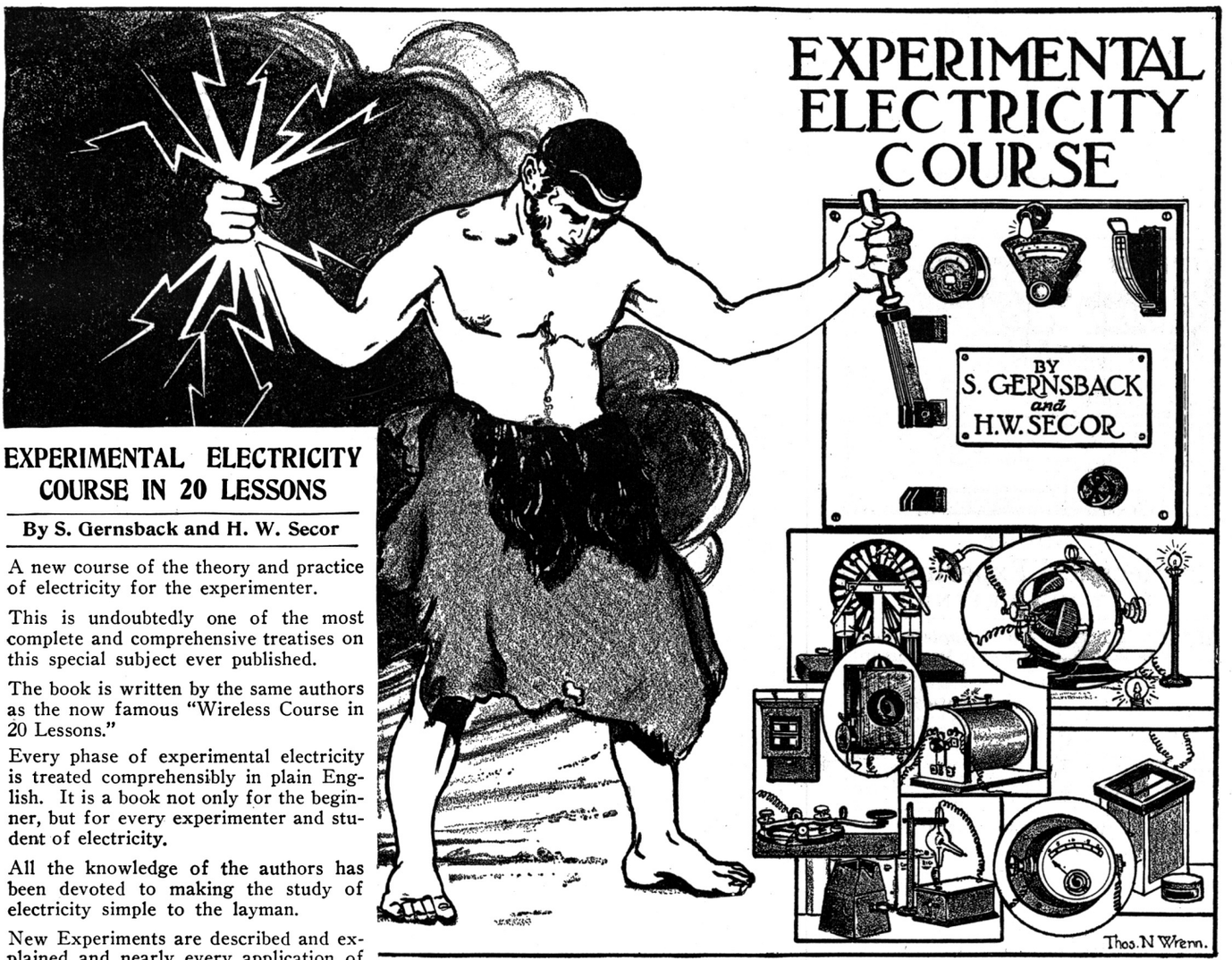

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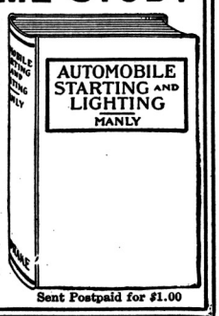

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UNEVEN OLD WAY

AN IMPROVED AMPLIFIER FOR RADIO AND PHONOGRAPHS.

(*Continued from page 412*)

ture construction and is secured to the journal arm of the reproducing head as indicated. This microphone is composed of a tiny diaphragm placed in a metallic frame, but insulated from it, while fine granules of carbon are placed in a cup which is secured to the frame. Connections are made from the diaphragm and carbon grain cup. The instrument to the right is one of the loud speaking telephones. Of course several of them can be connected in parallel and controlled by switches, as indicated in front of the phonograph. In paralleling the telephones great care is taken to equalize the resistance of each microphone so as to obtain the maximum results. The device to the left is an acoustic resonator and is used for tuning the diaphragm of the receiver with that of the horn used so that both may be in resonance.

This phonographic arrangement can be put to many uses; for instance, music can be sent to numerous places such as cafés, hotels, dance halls and gardens. A similar scheme has been in use in a prominent Chicago hotel, where the people living in the hotel are called out to meet their friends at the entrance. This is done by placing several loud speaking telephones around each hall which are connected to a common microphone. This in turn is placed on a phonograph which contains the name of the party who is to be called. The name of the person is sounded in every part of the building until he answers, then the machine is stopped and made ready for another call.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 422*)

boil as do other liquids. The nitrogen boils at a lower temperature than the oxygen (Nitrogen having a boiling point of -194 degrees, under the pressure of one atmosphere. Oxygen boils at -181 degrees, under the same conditions.) This permits a large proportion of the Nitrogen to escape ahead of the Oxygen, the latter being collected separately in the gaseous state.

5. By heating Lead Nitrate ($Pb(No_3)_2$), and other nitrates.

6. By heating Manganese Dioxide (MnO_2) in an iron tube with the high temperature of a gas burner. During this process only part of the Oxygen is separated, leaving behind another oxide (Mn_3O_4).

PROPERTIES OF OXYGEN.

Chemical Properties.

1. Oxygen combines readily with most elements to form oxides. (It does not, however, combine with Bromine (Br); Argon (A); Fluorine (Fl); or Helium (He.)

2. It is a supporter of ordinary combustion. (This is one of the chief chemical properties of oxygen.)

3. Sustains life by combining with the blood.

Physical Properties.

1. It is a colorless, odorless and tasteless gas.

2. It is 16 times heavier than Hydrogen.

3. A liter at Standard Temperature and Pressure (S.T.P.) weighs 1.43 gram.

4. It is slightly soluble in water. (100 cc. of water dissolves about 3 cc. of oxygen).

5. It can be liquefied and frozen.

6. As a liquid it is a pale steel-blue, transparent mass, and boils at -181 degrees (with the pressure of one atmosphere).

USES OF OXYGEN.

1. The main use of oxygen is the respiration of animals, fishes, etc.

2. As a general supporter of combustion, and in the laboratory as an oxidizer.

3. It is used to support life in subma-

MAGAZINE DONATES $10,000.

Our Readers May Profit by Generosity of Western Magazine Firm.

A well known Denver publishing house has appropriated $10,000 to be used solely in a whirlwind circulation campaign. Their offer is so liberal and the magazine so interesting that everybody is eager to send in their names.

The magazine referred to is 13 years old and each month publishes stories of adventure, numerous engravings and sketches of western life, cowboy capers, descriptions of famous ranches, irrigation projects, land news, rich gold mines, etc., and tells how and where to get homesteads. It is the oldest, largest and finest magazine in the west. Readers say it is worth $3, but in this surprising circulation campaign the publishers are spending their money like water and our readers may subscribe three whole years for only 25 cents, six full years for 50 cents. It is the biggest honest offer ever made. Remit in cash, postage stamps or money order. Tell all your friends. This offer may not appear again. Send today. Money back if not delighted. Mention the Electrical Experimenter and address **Rocky Mountain Magazine, Station 2, Denver, Colorado.** (Adv.)

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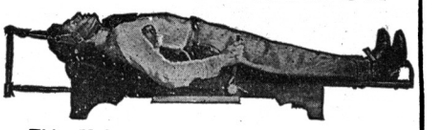

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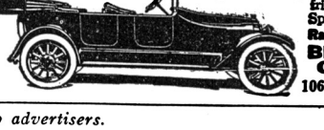

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rines; in diving bells; during balloon ascensions to a great height, and also for the respiration of deep-sea divers.

4. In medicine it is used for artificial respiration, or is administered to a person who has been suffocated; in cases of pneumonia, croup, asthma, or extreme weakness; for chloroform poisoning and in cases where other poisonous gases threaten death.

5. It is used with chloroform to produce an anaesthetic.

6. One of the chief commercial uses of oxygen is the Oxy-hydrogen blowpipe (see figure 20 "a" and "b"), which consists of two tubes as shown. The hydrogen is allowed to pass through the outer tube and combines with the oxygen (which is passed through the inner tube) under pressure and produces a blast, which is found to radiate intense heat. This flame is used extensively for cutting iron girders; for welding and for melting platinum and other highly refractory materials.

If a stick of quicklime is introduced at the tip of the flame, it does not melt, but becomes white-hot, giving an intense white light (similar to that of acetylene), which is known as the *limelight* or *calcium* light.

THE ELECTRIC VEHICLE HAND-BOOK. By Cushing and Smith. 400 pages; 161 illustrations; flexible leather covers; 6½ x4¼ inches. Price $2.00. Published by H. C. Cushing, Jr., New York City, N.Y.

Several engineers have contributed their experiences in compiling this book on electric vehicles. The idea of assisting the owners of electric cars to obtain the highest efficiency possible, has been carefully carried out.

Every phase of the subject was carefully considered and the best practice detailed in this book. Naturally, the construction, use and care of different types of storage batteries occupies the most space. The pages on battery charging give a full description of charging panels, rectifiers, measuring instruments and recording apparatus. Lead burning is described in detail with the apparatus used; also hydrometer readings; charging and discharging rates; also cadmium readings and their significance; motors, their mounting, connection and troubles; various types of controllers; care and handling of solid and pneumatic tires, etc., etc.

Owners of electric vehicles will welcome this volume, as it is a valuable guide for drivers and garage-men.

OXY-ACETYLENE WELDING AND CUTTING. By Harold P. Manly. 215 pages, 55 illustrations; cloth bound, 6¾x4½ inches, price, $1.00. Published by Frederick J. Drake & Co., Chicago.

This book is intended particularly for those whose duties bring them in touch with the actual work of welding and cutting with oxy-acetylene gas. The alphabetical index and accurate data will benefit the expert welder.

Metal, alloys and heat treatment, acetylene generators and auxiliary apparatus are covered before the real subject is taken up. Twenty pages are devoted to instructions on the preparation of the work, use of the torch, control of the flames and tables required in welding operations.

Beside gas welding, electric welding of different kinds, hand forging and other methods of joining metals—such as soldering, brazing and thermit welding—are explained. The last chapter is devoted to the oxygen process of removing carbon.

LABORATORY MANUAL OF ALTERNATING CURRENTS. By Lloyd C. Eddy, M.E., Ph.B. 81 pages; 21 illustrations; cloth bound; 8x5½ inches. Price 50 cents. Published by D. Van Nostrand Co., New York.

Among experimenters there is a noticeable lack of understanding concerning alternating currents. While this book was brought out to be used as a text-book, it will be very valuable to the student who wishes to try the simple experiments with very little equipment.

There are thirty separate experiments explained in an elementary way, covering the effects of choke coils, condensers, inductors, characteristics of transmission lines, delta or star connections, transformer regulation, and other subjects which must be understood before the more serious work is attempted by any student. It is one of the best books of its kind we have seen recently.

MECHANICAL ENGINEERS' HANDBOOK, based on the Hütte. By a staff of specialists. Lionel S. Marks, Editor-in-Chief. 1836 pages, profusely illustrated. Thumb indexed. Leather covers, gilt edges. Price $5.00. 1916. Published by the McGraw-Hill Book Company, New York City, N.Y.

The first edition of a new visitor in the realm of engineering hand-books. This pretentious volume will prove to be a fresh store of information to all workers in technical lines. A prodigious amount of labor has been expended in preparing this treatise of boiled down facts in order to make them easy of access to the engineer, yet replete with all necessary facts and data bearing on a certain problem. There are fifteen sections, thumb-indexed, covering the physical and practical designing considerations on most everything imaginable, from the flow of liquids through pipes to the stresses in a steel skyscraper frame.

Some of the important subjects treated upon at length are: Mathematical Tables and Weights and Measures; Mathematics (very complete, dealing with Geometry, Calculus, Graphical Representation of Functions, and Vector Analysis); Heat; Strength of Materials; Materials of Engineering; Machine Elements; Power Generation; Hoisting and Conveying; Transportation (including automobile engine and chassis data, load on tires, bearings, electric vehicle data, etc.); Building Construction and Equipment; Machine Shop Practice (details as to power required for driving various machine tools, heat-treatment of high-speed tools, industrial management, cost and other factory accounts); Pumps and Compressors; Electrical Engineering; Engineering Measurements; Mechanical Refrigeration, etc.

Then there are timely and practical sections on Gyroscopes, Oil Fuel for Boilers instead of Coal; Chemistry; Alloys and their composition; Foundry Operations; Ball Bearings; Gearing; Pulleys; Belts; Boiler Installations and Piping; Gas-power Plants; Gas Turbines; Turbine Design; Tidal Power; Cranes; Locomotive Performance; Track Lay-outs; Aeroplane Design (with formulae on wing pitch, air resistances, stability and propeller blades, also data on existing aeroplanes); Reinforced-concrete Construction; Steam and Hot-water Heating; Fire Protection; Molding Machines; Design of Air Ventilating Fans, etc., etc.

All in all, this book is a most worthy addition to our technical literature and a work that all those vitally interested in the subjects embraced should have at hand. Most books of this nature which include odd subjects tend to fall short on the necessary every-day data which they should contain, but the editors of this excellent book have certainly to be complimented on the thoroughness with which they have accomplished their task.

WIRELESS TELEPHONE IN ITALY.

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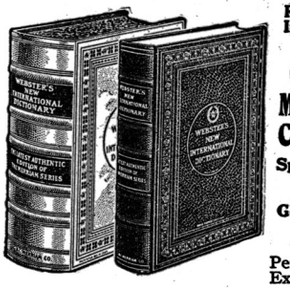

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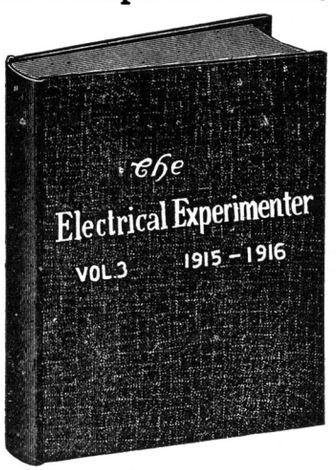

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Of course, my mail very frequently brings me in letters of unusual interest. Only the other day I received a complaint that *"The Electrical Experimenter"* was devoting too much of its space to advertisements.

Naturally, a statement of that nature strikes pretty close to home and I thought I would check up *"The Electrical Experimenter"* with some of the more popular fiction magazines now being published.

I was surprised to find that not only was *"The Electrical Experimenter"* devoting MORE space to actual reading matter and illustrations than those to which comparison was made, but I also found that we were giving twenty, and in some cases *thirty-three per cent more text* than practically 50% of the magazines on the market to-day.

Some day when you have a little spare or leisure time and you really are interested in seeing what a literary bargain you get, just compare the amount of space *"The Electrical Experimenter"* devotes to advertising and editorial matter with your next best favorite periodical and see what you get there for the same price.

I think you will admit that the balance is very much in favor of *"The Electrical Experimenter."*

MILTON HYMES.

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THE motor is a marvel of accuracy and precision, driving the turn-table with an evenness of speed that does not vary a hairbreadth in a thousand revolutions.

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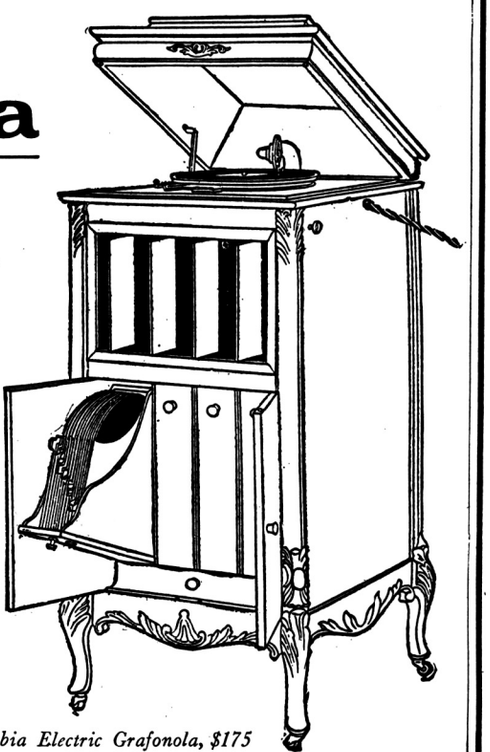

Columbia Electric Grafonola, $175

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 70,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: *Two cents per word* (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 30c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the November issue should reach us not later than September 25th.

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OVER 70,000 PEOPLE READ THIS JOURNAL

WILL PAY 50c. for a burnt out Audiotron bulb. Must be unbroken. Matt Jarosz, 3510 N. Narragansett Ave., Chicago, Ill.

HOLTZER CABOT PHONES, special winding 5,000 ohms, very sensitive, cost $17, sell $7.50. Chief Electrician, U.S.S. Newport, Navy Yard, Brooklyn.

WANT—Four clincher bicycle rims without spokes, and two tires. Want Motorcycle engine for wireless outfit. All letters answered. Harry Ostness, River Falls, Wis.

WILL EXCHANGE Smith Motor Wheel in good running order for good receiving apparatus or sending apparatus or both. Motor Wheel cost $85.00 last year. Have also 1800 M. Loose Coupler. Will swap for tuner. All letters will be answered if a 2c. stamp is enclosed. Lloyd Packer, 923 E. Warner Ave., Guthrie, Okla.

FOR SALE—Two ½ K.W. Transformers, choke coil, condenser, sending key, rotary spark gap 4,000 R.P.M. A.C. or D.C., three Audion bulbs, rotary variable condenser, two motors for rotary spark gap, 110 volts, dynamo, water motor, four ½" spark coils, 10,000 meter loose coupler, three loading inductances, 3,000, 2,000 and 1,000 meters, ammeter, three receiving sets, 2,000, 1,000 and 500 miles. Will sell cheap. Please enclose 2c. stamp. Kenneth L. Jennings, 569 Norfolk St., Mattapan, Mass.

HAVE new $85 No. 5 Oliver Typewriter—long carriage. Desire Large Radio Transmitter or Receptor. Ray Atkins, Groesbeck, Texas.

FOR SALE—240 ft. 4 strand antenium wire and 8 ball insulators (glazed). Never used and in A1 condition. Price $2.60. H. D. Buchanan, 814 So. 8th St., Camden, N.J.

WILL EXCHANGE New Audiotron bulb for a one-thousandths capacity variable condenser. C. V. Harney, Kinsley, Kansas.

FOR SALE—Nichols Receiving Set No. 201. Cost $3.75. Sell $2.50. Good as new. R. B. Tenny, Jr., 1215 Franklin St., Waco, Texas.

FOR SALE—One kilowatt closed core transformer, jar condenser, helix and key. Make me an offer. J. E. Wood, 295 Ohio Ave., Providence, R.I.

FOR SALE CHEAP—½ K.W. mounted Packard $8, Murdock gap $12, oscillation transformer $2. Audion with new bulb $8, Holtzer-Cabot 3,000 ohms $5, and Blitzen receiving cabinet complete with loading coil and switch $20. These instruments used less than four months and in good condition. Hale G. Smith, Osage, Iowa.

A.A. CRYSTALOI $3.00, Manhattan Variable Condenser $1.00, Ferron Detector $1.25, Blitzen 2,500 meter Loader $1.00, Murdock Loose Coupler $7.00. All new. J. Smith, Trout Run, Pa.

FOR SALE OR EXCHANGE—Arlington Coupler, 2,000 ohm Murdock headset, fixed condenser, 650 feet wire, ground switch, four baby knife switches, parts of unfinished couplers. Make an offer. Arthur Brown, 22 Bay View Ave., Danvers, Mass.

FOR SALE OR TRADE—Universal detectors, Junior fixed condenser, a pair of 2,000 ohm phones and a Junior Loose Coupler. What have you? Raymond Katzenberger, Tippecanoe City, Ohio.

FOR SALE—New 100 lb. barbell, Indian novelties, Tattoo Outfits, nickel cornet, and photos M.P. Stars. Frank Saunders, Richmond, Me.

FOR SALE OR EXCHANGE—Complete sending outfit consisting of 110 Volts, ¼ K.W. Transformer, Moulded Condenser, Spark Gap, Key, Choke Coils, and Resistent Coils. Will sell for $9.00 or exchange for Audion. Willis L. Otto, Cambridge, Ill.

EXCHANGE—$35.00 diamond stud; $11.00 Omnigraph, new, with continental code, for radio or Tesla apparatus; state make and capacity. All letters answered. P.O. Box C34, Red Bluff, Cal.

WILL EXCHANGE experimental apparatus and sporting goods for visible typewriter. Send description and what you desire. W. J. Benson, 2808 N. Lawrence St., Philadelphia, Pa.

FOR SALE—Loose Coupler $3.25, cost $5.00. Capacity 1,500 meters. New, never used, one loading coil in cabinet $1.75, capacity 2,500 meters. Don't write, send for bargain. G. Slater, 438 Madison Ave., New York City.

WANTED—A good one or two cylinder second-hand motorcycle or motorcycle engine, complete, at a reasonable price for cash or electrical goods. Give description and price in answer. Don Ringo, Paris, Ill., R.R. No. 3.

CHAMBERS loose coupler, new, $3.50. Miller, 33 Windsor Place, Brooklyn, N.Y.

FOR EXCHANGE—One six volt battery motor, one pair of tubular ice-skates, racing model, with shoes attached; shoes are size 5½. These skates cost me $11.00. Also one of the Multi-Audi-Fone Co.'s pocket wireless sets which can be seen in the E.E. I want either a pair of Brandes Navy or Transatlantic phones. May also consider a pair of Stromberg-Carlson phones. Geo. Schadt, c.o. D. P. Winne Co., 105 Worth St., New York City.

FOR SALE—¼ K.W. Blitzen Transformer, $9.50; Superior Head Set, $3.00; two battery telephones, $1.25 each; set screw plates, 4/32 to 12/32 taps and dies, with tap wrench in neat case, brand new, $3.00; Franco Ammeter, O to 35 amps., new, 65c. Also have back numbers of Modern Electrics, since March, 1912. Arthur Osborn, Wenatchee, Wash.

DIE for making storage battery plates, $6.00; one step down transformer, $3.00. T. A. Eberhardt, 938-30 St., Milwaukee, Wis.

FOR SALE—Type AA Crystaloi, $4.00; Murdock $7.00 Loose Coupler, $4.50; 75 ohm headset, 65c. Earl Fischer, 392-31 Ave., Milwaukee, Wis.

COPY your Radio message on a Telegraphone. Telegraphone talking and reproducing head for sale or exchange. Also a fine Weston Milliampere meter, excellent for radio measurements. Want small A.C. 60 cycle motor or ¼ K.W. transformer or what have you? Samuel Cohn, 1936 Pitkin Ave., Brooklyn, N.Y.

WANTED—A carborundum detector, particulars. Miller, 33 Windsor Place, Brooklyn, N.Y.

INDIAN MOTORCYCLE—1914 Service Single, good condition, fully equipped, Prest-o-lite. Sell for $60 or exchange for electrical apparatus. Oliver Ramsaur, West Raleigh, N.C.

FOR SALE OR EXCHANGE—4,000 meter loose coupler, value $6.00. E. I. Co.'s one-inch spark coil, value $3.00. J. Fritz, 748 Clinton St., Pottsville, Pa.

FIRST ORDER for $3.75 takes brand new $7.00 electric post card projector. Shows diagrams, hookups, etc., on screen 9x12 feet. See my ad in the August EXPERIMENTER. D. Goodman, 418 W. Court St., Flint, Mich.

FOR SALE—My own make large navy type coupler, consists of the following: Brandes Superior 2,000 ohm Headset, Murdock fixed condenser, guaranteed galena detector, buzzer and switch, on primary 30 taps, secondary 12. All parts mounted on a fine mahogany finish base 10x20. With the average aerial I can hear Arlington, Key West, and many other commercial stations. This set is guaranteed to work right. Price $20.00, postpaid. Ira M. Sensenick, Lititz, Pa. R.R. No. 3.

EXCHANGE—My ½ K.W. Transmitting set, complete, for single Cylinder Motorcycle or Motorcycle Engine. G. M. Burchnell, Monroeville, Ind.

FOR SALE—2,000 ohm Commercial Wireless Receivers, $4.00; 1½ inch Mesco Coil, $6.00; Murdock Section, $1.00; Gernsback Interrupter, $1.00; Volt Meter, 50c.; 1,000 meter Double Slide Tuner, $1.50; dandy Spark Gap, $1.75. John J. Oetjen, 543 17th St., West New York, N.J.

FOR QUICK SALE—Two loose couplers, two loading coils, variometer, galena detector, two D.P.D.T. switches, two-bulb audion detector, three Murdock variable condensers, pair 3,000 ohm phones, audion test board, ½" coil, gap, and key, 200 watt step-down transformer, omnigraph, knobs, studs, switch parts, guy wire, and books. Wireless apparatus mounted on hard rubber in excellent condition. Photo and description for stamp. H. L. Dearborn, Lincoln, N.H.

LOOK—Have Mysto Erector, will take $4.00 or trade for .22 calibre Rifle. Earl E. Cook, Bernardston, Mass.

WANTED—Electro ground switch, Radioson, Crystaloi, 43 plate Variable, Electro loader, Electro fixed variable, 400 ft. stranded wire, 20 ball insulators. Describe fully. Fred Cookson, 442 Duncan St., San Francisco.

FOR SALE OR EXCHANGE—Bicycle; will exchange for 6-60 or 6-80 Storage Battery or for cash. Make an offer. R. B. Lamscha, Butler, N.J.

NEW ½ K.W. Thordarson transformer; Sixth H.P.A.C. Motor, fine condition, for sale or trade for 1 K.W. Thordarson, balance cash. Want variable Condensers. What have you? Roy Featheringham, Postal Telegraph Co., Massillon, Ohio.

FOR SALE OR TRADE—Large glass plate condenser, $3.00 Wireless Telephone arc, $1.00. Battery motor, 50c. New tinfoil, 20c. per lb. New Electron Relay, potentiometer control, $8.00. Ralph Leffler, Tiffin, Ohio.

WANTED—Two inch spark coil, perfect condition, make offer. Woody, 4238 Evans Ave., Chicago, Ill.

FOR SALE—Receiving Set, loose coupler, loading coil, 2 detectors, condenser, potentiometer, buzzer and battery. Good condition. Hear Arlington loud, regularly noon and night on small indoor aerial. Price $8. Claude Moore, Caro, Mich.

SELL OR TRADE—One type E Clapp-Eastham receiving transformer, $12, or trade for standard 110 V. A.C. Rotary Gap, two new audiotrons or ½ K.W. Quenched Gap. Wm. G. Wagner, Big Creek, Cal.

FOR SALE—100 ft. Aerial, Aerial Switch, Audion and Mineral Detectors, 4" Spark Coil, Spark Gaps and other accessories at reasonable prices. Meyer, 3574 Park Ave., New York City.

FOR SALE—Thousand ohm receiver, headband, cord, Universal detector, Junior condenser, connection block, fifteen hundred meter tuning coil, all for $3; one indoor telephone, $1; No. 4 American model builder with Lionel motor, $4. George Koresh, 419-50 Ave., West Allis, Wis.

WANTED—No. 9300 Electro Radioson detector, No. 9255 Electro rotary potentiometer. Must be in good condition. I have wireless instruments to trade. Mathew H. Fife, Wilmington, Ohio.

FIRST $5.00 takes wireless set. Consists of tuner, loading coil, condenser, detector, buzzer and 1,000 ohm headset. Donald Morris, N. Court St., Circleville, Ohio.

BARGAIN—Jefferson step-down transformer, $3.00; Duck's 4,000 meter loose coupler, $6.00. Used only short time, good as new. Paul Barrett, 3150 Central Ave., Indianapolis, Ind.

FOR SALE—Hawkins' Electrical Guides, ten volumes, $7.50 prepaid. Hawkins' Electrical Dictionary, $2 prepaid. Volumes 28 (6), 29, 30, 31 World's Advance bound in leather, $1 each, prepaid. All good as new. Want Radioson, little used. H. N. Johnson, De Kalb, Ill.

FOR SALE—An E. I. Co.'s Transcontinental Receiving Set. Never been used. First remittance of $12.00 takes it. N. Moses, 1566 Washington Ave., Bronx, New York City.

WANTED—3 pair Guinea Pigs. Have for sale Belgian Hares, also pure copper ground rods 6 ft. long, 90c. each. L. H. Hammond, Badin, N.C.

6 VOLT 80 A. H. Philadelphia storage battery, cost $16.00. 6-9 Volt ⅛ H.P. D.C. Motor Holtzer-Cabot, cost $14.00. Hoyt 12 Volt D.C. Volt Meter, cost $6.00. Warner water motor with pulley, all in first class condition. Swap for good shot gun, or sell. William M. Learned, 78 Lowell St., Methuen, Mass.

FOR SALE CHEAP—Commercial key, three phones—one "Brandes Superior," two helices, home made loose coupler, large tuner, galena-silicon detector, tinker; Electro's Jr. tuner, large and small condensers, forty feet No. 4 copper wire, switches, twenty foot pipe mast and guys, two pounds Antenium wire, miscellaneous wire, insulators, electro-magnets, etc. Must sell, $8 takes it. Burnett Jones, Hampton, Va.

WANTED FOR CASH—1 K.W. sending transformer, Thordarson preferred. Also hot wire meter, 0-5 amp. rotary spark gap motor, ½-¾ inch spark coil, ½ doz. telegraph keys, a couple sounders, and 4—75 ohm telephone receivers. Carroll Pfleegor, Milton, Pa.

WANTED—110 Volt A.C. fan, Violet ray outfit, powerful microscope, orchestra bells, Xylophone, ½ gal. Leyden jars. Have electrical goods (none wireless), fine coin collection, tools and several other articles. Write quick. Emil Hoerz, 241 W. Hickory St., Kankakee, Ill.

EXCHANGE—2,500 meter loose coupler, Crystaloi AA with buzzer, Electro Junior fixed and Gernsback variable condensers, Transatlantic phones, 6 volt power motor, 110 volt fan motor, 65 note Pianola and bench. Wanted, 4 inch spark sending set, Brandes phones or cash. G. L. Woodruff, 2345 Broadway, New York City.

HAVE two bicycles and miscellaneous supplies and material for cycle car chassis excepting engine. Want wireless, electrical apparatus or cash. Leland Franzen, Newman, Cal.

HAVE 500 feet moving picture film, make offer. Theodore Getzler, 60 E. 120th St., New York City.

NEW $4 MURDOCK variable condenser, 43 plates, $3. Round DeForest audion bulb with one filament, $4. Herbert Moershfelder, 34 Ketchum Place, Buffalo, N.Y.

1,500 METER navy type coupler, $3.50. Pancake helix, no clips, 75c. Potentiometer, 35c. All postpaid. Kenneth Kruger, Canton, N.Y.

WANTED—DeForest Audion detector. Have rotary gap to exchange. Also have several small motors to exchange. Warren Benson, 4 Fuller Place, Brooklyn, N.Y.

WANTED—Brandes Phones, must be in good working order, state model and price wanted; also two Crystaloi detectors. W. N. Curry, Sweet Springs, Mo.

SALE OR TRADE—Acetylene Cannon—K. D. Motor—25 calibre single shot rifle with case. Have also 2x4 ft. pool table with outfit. Want two cylinder gasoline engine and Aviation Books. C. Weyand, 48 Dodge St., Buffalo, N.Y.

SALE OR EXCHANGE—2 K.W. compound-wound generator, 1/10 H.P. 110 V., D.C. Emerson Motor, ¼ H.P. water-cooled gasoline engine, Morse sending attachment for typewriter, strong spring motor. Want Multi-Audi-Fone, variables and 15,000 m. coupler or equal value. H. J. Kohli, Pandora, Ohio.

BARGAIN—1,500 meter receiving transformer, $3.50; Amco type rotary gap, $4; oscillation transformer, $1.75; Murdock loading coil, $1.25. Stuart W. Pierson, Carrollton, Ill.

FOR SALE—1 H.P. Elgin gasoline engine, $12; 75 watt dynamo or 1/6 H.P. motor, $8; large receiving transformer, tunes up to 4,000 meters, $6; Mandelette One Minute Camera with post cards and solution, $3; Ferron detector complete with ferron crystal and marble base, $3.50; Murdock 3,000 ohm receivers, $3.50; ½ inch spark coil, $1.75; E. I. Co. Static Machine less condensers, $3; Voltammeter 0-25 V. 0-30 A., $2.50; large stationary spark gap, 75c.; small condenser, 35c.; tubular condenser, 3 inches long, 35c.; glass plate condenser, 5½x7½ inch, 50c.; 2x4 inch condenser, 50c.; small size X-ray tube with stand, $2.50; wireless key, 75c.; .22 calibre rifle, $2. All above articles in good working order. Bud Hartmann, 73 Liberty St., Meriden, Conn.

FOR SALE—1 Electric Locomotive Outfit, Pennsylvania line type, new, $5. 1 type SS Dynamo Motor, $2.. Will exchange. Theo. Lambert, 709 N. 25th St., Birmingham, Ala.

WANTED—Pair of Brandes Navy Phones. State condition and price. Cecil Mathers, 201 Avenue C, Miami, Fla.

SALE OR EXCHANGE—3 vol. I. C. S.'s International Library of Technology on Electricity; Electrical books, magazines; polarized relay; 2 pony relays; 1½ inch complete sending set; telephone magneto, induction coil, 3 condensers; blow torch; alarm clock works; 2 spring motors; automatic razor strop; hair clippers; flashlight; wool coat sweater; toy motor. Want audion, amplifier, bulbs; ½ K.W. transformer; key; switches and points, raw material; experimenter's tools; Omnigraph; folding Kodak; 2 1,000 ohm receivers; Edelman's "Experimental Wireless Stations"; dynamo-motor. Greer W. Peck, Springfield, Tenn.

FOR SALE—Experimental electrical and chemical laboratory apparatus. Send for lists. Owner leaving city. Walter M. Downing, 1651 Mt. Vernon Ave., Columbus, Ohio.

LOOK—Static Machine, perfect condition, $3.25; Inch spark coil, $4; seven-shot .22 caliber revolver, $4.50; cost $5.40 month ago; Bunnell double speed key, new, $2.25. Coyd Maffet, Opal, Colo.

FOR SALE OR EXCHANGE—One Champion valve alto trombone horn worth $25. Will take $15. Also one pop corn and peanut machine in good running order, cost $120. Will take $25. A. I. Darnall, Searcy, Ark.

FOR SALE—Blitzen Receiving cabinet with 3,200 ohm navy type phones, R.C. 9 audion and ferron detectors, Blitzen loading coil; necessary aerial wire, insulators, etc. Cost $65, sell for $42. Will install this set anywhere in Massachusetts for $45. Ralph A. Clarke, 74 Barre, Mass.

FOR SALE AND WANTED—Will sell Colby Receiving Transformer, $3.25; Crystaloi, $1.50; Chambers Oscillation Transformer, $3.50; Rotary Gap Ring, 75c.; Loose-Coupler, $4.50; WANT: Navy Type Loose-Coupler, Drawing Instruments, Murdock Condensers, Long Distance Telephone Transmitter, Spark Coil Secondary. E. C. Braatz, Lowellville, Ohio.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

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BOOKS

HAVE YOU SEEN A COPY?—Amateur Photographer's Weekly, $1.50 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription, 40c. Amateur Photographer's Weekly, 915 Schofield Bldg., Cleveland, Ohio.

BOOKS—Scientific and wireless supplied. Let us know what you want and we will quote you. Experimenter Pub. Co., 233 Fulton St., New York City.

A BINDER for The Electrical Experimenter will preserve your copies for all time. Price 50c. Postage on 3 lbs. is extra. Send for one today. Experimenter Pub. Co., 233 Fulton St., New York City.

MISCELLANEOUS

10c. Flashlight attachment for ordinary dry cell. Thos. Johnson, 1438 N. 18th St., Philadelphia, Pa.

MAGIC Three Card Tricks 10c, fools them all. M. Daley, 527 State Street, Bridgeport, Conn.

SMALL GASOLINE and steam engines, engine castings, dynamos, motors, storage batteries, electric light plants (200 watts up), tools, gears, pulleys, etc. Catalogue and circular for 5c. Dynamic Manufacturing Co., First National Bank Bldg., Chicago.

YOUR PRESENT ABILITY to earn can positively be increased 50% by learning the advertising business. Write for facts. Page-Davis Co., 23 Page Bldg., Chicago, Ill.

100 NEATLY PRINTED VISITING CARDS 49c. Handsome card case given FREE with each order. Send stamp for sample. The Prudon Specialty Mfg. Co., 921 Demott St., North Bergen, N.J.

STAMPS—75 all different, free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

PATENT ATTORNEYS

AMERICAN AND FOREIGN PATENTS obtained. Before selecting an attorney, write for our solid, instructive advice; join the ranks of happy inventors. Correspondence Office, 125 East 23rd Street, New York City. F. V. Winters, Reg. Patent Lawyer, New York City and Washington, D.C.

PATENTS SECURED OR FEE RETURNED—Send sketch or model for free search and report. Latest complete patent book free. George P. Kimmel, 254 Barrister Bldg., Washington, D.C.

JOHN M. McLACHLEN, attorney-at-law—Patent causes. Union Trust Bldg., Washington, D.C.

IDEAS WANTED—Manufacturers are writing for patents procured through me. Three books with lists of hundreds of inventions wanted sent free. I help you market your invention. Advice free. R. B. Owen, 130 Owen Bldg., Washington, D.C.

PATENTS without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D.C.

INVENTORS—We perfect your invention, make samples, Dies, Stampings and do manufacturing. Easy terms. 22 years' experience. Backer & Gerding Mfg. Co., 121 Opera Place, Cincinnati, Ohio.

PHOTOGRAPHY

PHOTOGRAPHY WITHOUT CAMERA—Novel social pastime, using photo paper invisibly prepared with interesting and artistic pictures. Samples prepared for 25 pictures with directions, 10c. Wedge Mfg. Company. "Km," Binghamton, N.Y.

FILMS DEVELOPED FREE—Send negative for sample print and particulars. New Lex Novelty Co., New Lexington, Ohio.

MARCONI—We have a limited number of pictures of Guiglielmo Marconi that are done in sepia on fine India paper. Fine for decorating your wireless room. Ten cents each, postpaid. Experimenter Publishing Co., 233 Fulton St., N.Y.

WIRELESS

ARLINGTON TESTED LOOSE COUPLERS—$5.00; summer sale of receiving sets, stamp for circulars. Cliff Mfg. Co., Brookfield, Mass.

AUDION—Burnt out round De Forest Audion Bulb, $2.00, two filament "S" grade bulb, $6.00. Cahn, 215 Greene St., New York.

IF YOU ARE planning a transformer let us show you how we can save you money on the secondary windings. Made right and guaranteed. Tubes wound for loose couplers. State your wants plainly. Eureka Secondary Co., 6937 S. May Street, Chicago, Ill.

WE ARE Middle West agents for the Electron Relay. Avoid delay. Order from us. Blue prints of new easily made 15,000 meter coupler, 25c. Ironton Radio Sales Co. (not inc.), 510 S. 7th St., Ironton, Ohio.

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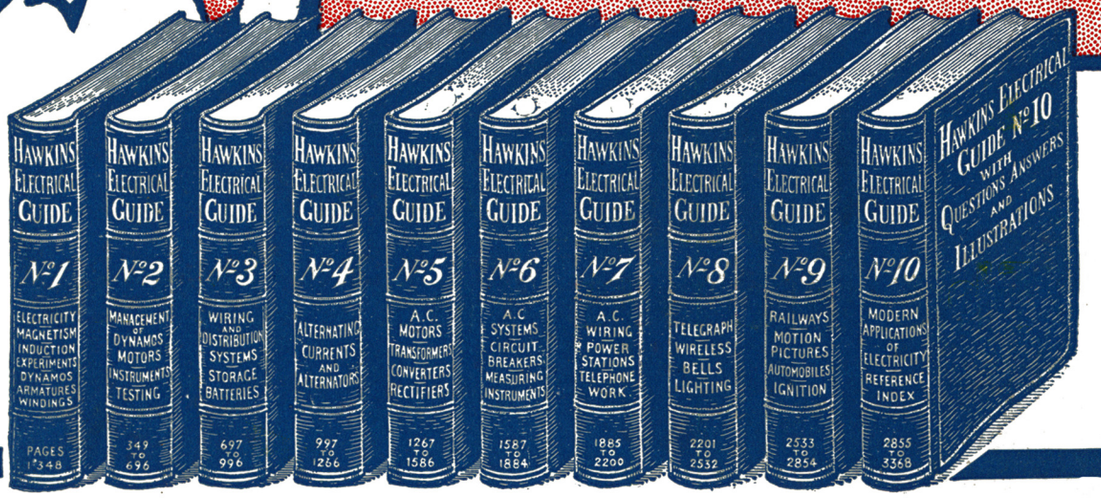

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